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ADVANCED MATERIALS

Italian Firms Form Italcompositi for Composites R&D

36980159b Rome *NOTIZIE AIRI* in Italian
Nov-Dec 88 pp 20-21

[Article: "Enichem-Agusta Composite Materials Research Initiative"]

[Text] The presidents of Enichem and Agusta (EFIM [Manufacturing Industry Holding and Financial Company] Group) have signed an agreement in Rome, creating Italcompositi, a jointly-owned company, for the specific purpose of carrying on research in the sector of new composite materials and of producing and commercializing raw materials and components made of such materials.

The agreement has been approved by the ENI [National Hydrocarbons Corp.] board of directors. It implements the prior agreement, arrived at in January, providing for cooperation between the Agusta Group and Enichem in the field of advanced materials for the aerospace, energy, and high-performance transport fields.

Of particular interest are the potential synergies in prospect between the two groups for the introduction of composites in other sectors, such as the railroad and defense sectors.

The new company is expected to have generated billings of 60 billion lire annually by the end of the first 3 years, and to attain a level of 90 billion annually beyond its fifth year. It has already received a few significant orders, including the body work for the F40, Ferrari's most prestigious production car.

The goal Italcompositi has set for itself is to attain shares ranging between 30 and 50 percent of the domestic market in Italy, together with progressive penetration of the European market.

In addition to the initial capital contributions made by the two partners, Italcompositi has investment programs planned amounting to 10 billion lire annually.

AEROSPACE, CIVIL AVIATION

Status of ESA's Horizon 2000 Project Reported

36980130a Stuttgart *FLUG REVUE* in German
Jan 89 pp 27-28

[Article by Michael Schaefer: "ESA Long-Term Space Research Program: Expanded Horizons"; first paragraph is *FLUG REVUE* introduction]

[Text] The ESA is making plans for European space travel up to the 21st century. Four research missions stand as the cornerstones of the long-term program Horizon 2000. There are budgetary problems: England refuses to agree to the necessary increase in allocations.

The giant step in expanding Europe's intellectual horizons was taken a little while ago: On 10 November 1987, the 13 member-states of the ESA [European Space Agency] agreed to four cornerstones for the long-term space research program, Horizon 2000. Building on the successes that European space travel has achieved over the last 20 years, Horizon 2000 is intended to secure the leading position of European space research and technology into the 21st century.

The cornerstones, which were agreed to on the ministerial level, constitute the ESA's obligatory program—the framework that holds everything together. This framework is complemented by the free section of the event: the flexible missions. These research projects will be defined and discharged by ESA bodies composed entirely of scientists, depending on need.

Even USSR Wants to Take Part

The four cornerstones of Horizon 2000 are:

- The Solar-Terrestrial Science Program (STSP), which is concerned with the electrical and magnetic interaction between the sun and earth.
- The X-Ray Spectroscopy Mission (XMM), an X-ray telescope for studying small, very distant sources of X-rays in space.
- The Far-Infrared Spectroscopy Mission (FIRST), concerned with infrared spectroscopy.
- The Comet-Nucleus Sample Return Spacecraft (CNSR or ROSETTA). This spacecraft is supposed to land on the nucleus of a comet, take material samples and transport them back to earth.

STSP, the program studying electromagnetic influences within the solar system, is the first undertaking, beginning in mid-1995. It consists of two parts. In the first part, the SOHO (Solar Heliospheric Observatory) probe, which weights some 1,350 kg, will be launched into orbit around the Lagrangian point at which it, 1.5 million kilometers away from the earth in the direction of the sun, will be kept in an elliptical orbit solely through the interaction of gravitation from the sun, earth and moon.

The second part of STSP, CLUSTER, consists of four identical satellites that will be put into an eccentric, polar orbit around the earth. With a diameter of 2.9 meters and a height of one meter, the launch weight of each of them is 904 kg. However, only 65 kg of this is payload—570 kg of fuel is required to shift course from an equatorial to a polar orbit. Cluster is intended to explore the plasma belts and plasma shell that consist of ionized solar wind particles captured by the earth's magnetic field.

STSP is being carried out in cooperation with NASA. The U.S. space agency will make available some of the parts of SOHO as well as the testing facility. In addition, there are plans for SOHO to be transported into space by the American space shuttle. The Europeans in turn will

build the SOHO spacecraft and the four Cluster satellites, and be responsible for the launch on board an Ariane 5 rocket. It is interesting that the Soviet Academy of Sciences wants to participate in the Cluster experiment with two of its own satellites. At present, the ESA is negotiating with the Academy's Space Research Institute (IKI) concerning the type of cooperation.

The definition phase for cornerstone two, the XMM X-ray telescope, has also been completed. Each of the three radiation collectors of the telescope, which measures over eight meters in length, will consist of several telescopic, gold-coated tubes made of fiber-reinforced synthetic material, with an external diameter of 70 cm and a length of 60 cm. Their collective surface area is equivalent to that of a 52 square meter parabolic mirror. XMM will make it possible to conduct X-ray spectral analysis on even extremely weak sources of radiation.

The definition phase for cornerstones three and four—the FIRST infrared spectroscope and the ROSETTA comet probe—have yet to be completed. For the eight-meter reflector of the FIRST satellite, there are two possible earth orbits available: a low one, inclined 28 degrees to the equator (low earth orbit—LEO) at an altitude of 500 km, or a sharply eccentric, inclined ellipse with a 12-hour orbit time. The elliptical course is being favored, since in that case less liquid helium must be transported in order to protect the measuring equipment—cooled to 4 Kelvin (-269 degrees Celsius)—from the earth's radiated heat: Only 2,040 liters are needed, compared to 6,000 with the LEO.

For the ROSETTA comet sample collector, there are two preferred objectives available—both Churyumov-Gerasimenko and Triton will be in accessible positions in 2002 and 2003. However, whether and at what point in their orbits around the sun ROSETTA will land on one of them, collect ice, rock and gas samples and then return to earth still depends on whether a high-thrust carrier rocket is available by the planned launch date in 1996.

With the Titan 4, Centaur G or Ariane 5 rockets, which are available now or will be in the near future, ROSETTA's on-board propulsion would be limited to a standard rocket engine with chemical fuel because of weight considerations, bringing with it the well-known drawbacks: limited orbital correction options and a smaller payload. By using a more powerful carrier rocket, however, the comet probe could be equipped with the heavy RIT-35 ionic beam engine developed by Messerschmitt-Boelkow-Blohm. If energy were supplied by solar cells, the ESA would essentially have a free hand in selecting the target comet and orbit for ROSETTA.

Cassini is the first of the flexible missions; on 25 November, it was selected from among a series of proposals and agreed upon by ESA scientists in Paris. It consists of a combined mission to explore Saturn and its moon, Titan. The space probe, weighing 5,100 kg, consists of

two segments: the orbiter, which will orbit Saturn and supply data on the planet's surface, its atmosphere, the rings and the area close to the planet, and the lander, which will land on Titan. Besides Earth, Titan is the only body in the solar system with a nitrogen-based atmosphere.

Great Britain Blocks Financing

As with STSP, cooperation between ESA and NASA is projected for the Cassini project as well. NASA will be responsible for the orbiter, based on the Mariner Mk.2 space probe, as well as for the carrier rocket and data transmission in space, while the Titan lander and its payload will come from the ESA. The lander will be guided and controlled from Europe.

As is always the case with projects such as this, the biggest test that Cassini must pass on its way to Saturn is on Earth—namely, money. Cassini will cost approximately DM 400 million. However, England does not want to go along with the increase in member-state contributions established by the ESA in November 1987, when the agency decided on an annual increase of five percent. But without this increase in allocations, the overall financing of the budget for the 20-year Horizon 2000 research program, which runs into the billions, is drawn into question.

Perhaps the planned expansion of European intellectual horizons will even take place without British participation. Prof Reimar Luest, director of the ESA: "I think it is even possible that England will withdraw from the ESA."

ONERA Chairman Summarizes Recent Activities AN890092 Paris *LE BULLETIN DU GIFAS* in English 9 Feb 89 pp 1-5

[Excerpt from annual activities report presented "recently" by Jean Carpentier, chairman of the French National Office for Aerospace Studies and Research (ONERA): "Main Results for 1988"]

[Text] ONERA, founded in 1946, is the scientific and technical organ of the French state and comes under the authority of the Defence Ministry. Activities involve production and marketing. From the very outset, the task of ONERA was one of development and orientation and to collaborate with the specialized organizations in charge of scientific and technical research for the purpose of coordinating national aeronautical and space research.

1. Aerodynamics

Numerical Methods

Special mention should be made of the progress achieved on strong coupling algorithms, which allowed computation of the flow in supersonic compressor cascades, with

multiple shock wave/boundary layer interactions and with large separations. In addition, the methods for solving the Navier-Stokes equations were extended to take into account the effects of real gas in hypersonic state and to compute turbulent 3D transonic flows. Numerical optimization techniques made it possible to decrease the drag of an airfoil by 50 percent for a transport aircraft. This decrease was confirmed by tests in the T2 wind tunnel of the Toulouse Research Center (CERT).

Another strong point resides in the methods for constructing meshes, with optimization and automatic adaptation. Thanks to such methods, we are now capable of calculating the flow around a complete Airbus A320 in landing configuration, with flaps, slats and landing gear extended. The same is true for the landing configuration of the Hermes spaceplane, as well as for the Ariane 5-Hermes assembly at liftoff.

Experimental Research

In parallel with this progress in the area of numerical methods, mention should be made of the record activity of the Chalais-Meudon R2 and R3 gust wind tunnels in 1988, both for military programs and for the Hermes and Ariane 5 civil programs. It should be stressed that the flow around the afterbody of the Ariane 5 launch vehicle was explored by laser velocimetry, which is a "first" in a gust wind tunnel. The success of these tests bodes well for the use of laser velocimetry in hypersonics.

2. Energetics

Turbomachines

A major series of tests for SNECMA [National Company for Aircraft Engine Studies and Construction] allowed the infrared signature of the jets from two nozzles simulating two M88 motors to be characterized. In addition, many results were obtained for cooling of turbine blade trailing edges. The analysis of injection at 40 bars and 1000 K can now be made operationally. This test apparatus is used to qualify the injection system of the THR/GE 36 engine (SNECMA-General Electric Unducted Fan).

The rapid development of the Diamant code for computing the 3D, viscous, reactive, unsteady flow in a turbomachine combustor should also be mentioned.

Furthermore, initial results were obtained with the Navier-Stokes 3D viscous flow computation code for analysis of flows in the blade rows of compressors and turbines.

Ramjets

In this respect can be mentioned the development of combustion chambers with walls cooled by a gas film. This work makes it possible to consider this type of

chamber for the future ramjet missiles. The advantage of the "semisolid" fuels developed by ONERA was also demonstrated for supply of medium or long-range missile ramjets.

Ballistic Missiles

ONERA closely collaborated with SNPE [National Company for Powders and Explosives] and G2P in the framework of exploratory development of an extinguishable/reignitable system.

Space Activities

The main work concerned ignition-startup of cryogenic motors (with SEP [European Propulsion Company] and MBB [Messerschmitt-Boelkow-Blohm]). A model of the Ariane 5 propulsion system is now under test at the Fauga-Mauzac Center.

Chemical Lasers

The quality of the research conducted by ONERA on the atomic fluorine generator allowed the CGE [General Electricity Company] to obtain excellent results with deuterium-fluorine power lasers.

Submarine Pumps-Propellers

We conducted work for DCW [expansion unknown] on the noise sources of this type of propulsion system.

3. Physics

Acoustics

In addition to the work already mentioned on pump-propeller noise, it should be noted that the test facility for motorized models with azimuth antenna, installed in the CEPRA 19 anechoic wind tunnel, allowed new progress to be made in analysis of the acoustic discretion of submarines.

Optics

We developed an airborne cryogenic infrared spectrometer to study the infrared signature of aircraft and missiles in flight, with performance levels an order of magnitude better than those of the current apparatus.

Electromagnetic Environment

A new flight test campaign on a Transall aircraft allowed better knowledge to be gained on lightning strikes on aircraft. In addition, the two SAFIR lightning warning systems, one of which is installed at the Landes Test Center and the other at the French Guiana Space Center, were operationally validated. Installation and operation of a SAFIR system at the Kennedy Space Center of NASA is now under consideration.

4. Materials

The results obtained cover a very wide range, from basic research to applications.

Ramjet Combustion Chambers

Trials were successfully conducted on two heat shield designs during tests simulating a long-range air/ground missile mission (low, then high, followed by low-altitude flight). One of the configurations tested included a film-cooled porous composite bull.

Turbomachine Disks

We decreased the size of the superalloy powders by gas jet dispersion, which should allow a reduction in processing cost.

SiC-SiC Composites

Impregnating harness sheets with a silicon carbide precursor polymer made it possible to obtain materials with characteristics equivalent to those of existing composites but with a processing time of a few hours instead of several months.

Microstructures Analysis Laboratory

The joint ONERA-CNRS [National Center for Scientific Research] laboratory, created around the 40 kilovolt microscope, includes researchers from both organizations. This will give research on physical metallurgy the scope required to develop new materials for the aerospace industry.

5. Structures

Aeroelasticity

This is one of the main specialities of ONERA.

- Aircraft: The vibrational behavior of structures was analysed for the ATR 72, the A320, the TB 700 light transport aircraft and the CAP 230 stunt aircraft with the aim of preventing fluttering.
- Helicopters: The test facility for studying the stability of helicopter rotors was placed in operation in the Chalais-Meudon S2 wind tunnel.
- Turbomachines: A model of the CFM 56 engine fan was tested in this wind tunnel.

Finally, ONERA confirmed its role as expert with the Directions Départementales de l'Équipement [Department Directorates for Equipment] for the stability of suspended bridges and cable-stayed bridges.

Structural Mechanics

Mention should be made of the success achieved in predicting the internal noise in a helicopter subjected to excitations by the propulsion system, experimental characterization of the vibrational and acoustic behavior of a pump, the design of programs for computing wave propagation in multilayer materials, which is of great interest for submarine acoustic discretion.

Fracture Mechanics

The simulation of cracking by local approach was developed and validated by confrontation with creep cracking tests. These results are a breakthrough at international level.

In the experimental field, mention should be made of the first high-temperature multiaxial tests (950 degrees Celsius) on monocrystalline alloys for turbine blades and the development of an ultrasonic method for in-situ observation of transverse cracking in composites. These results are original, at least at European level.

6. Large Test Facilities

Tests

There was much activity both on military programs and on transport aircraft programs.

For instance, we can mention the Rafale tests in the Modane S2 and S3 wind tunnels as well as the tests on the nuclear aircraft carrier in the Fauga-Mauzac Center F1 wind tunnel. And for the Airbus programs, testing on A330 and A340 motorized models in the Modane S1 wind tunnel.

For the THR high-speed propeller Turbojet program conducted by SNECMA in cooperation with General Electric, we can mention the test of the air intake and counter-rotating propellers in the Modane S1 wind tunnel and the afterbody in the R4 wind tunnel.

For helicopters, testing on rotors was resumed in 1988 in the Modane S1 wind tunnel with the new facility qualified in 1987.

We can also mention research test in the F2 wind tunnel (whose measuring equipment, in particular the 3D laser velocimetry, is highly appreciated by the teams of aerodynamics specialists), tests on the Ariane/Hermes assembly in the Modane S2 wind tunnel and the tests on the trial model of a rustic ramrocket.

Facilities

As concerns the S4 wind tunnel, the heater was refurbished, and the new Mach 10 and Mach 12 nozzles are scheduled for next April. The improvements and

extended capabilities of S4 are strongly desired by CNES [National Center for Space Studies], Aerospatiale and AMD-BA [Avions Marcel Dassault-Breguet Aviation] for the Hermes program.

Also for the Hermes program, ONERA was awarded contracts by CNES and ESA [European Space Agency] for the construction of the F4 high enthalpy wind tunnel. This wind tunnel benefits from very appreciable financial support by the Regional Council of Midi-Pyrenees and the General Council of Haute-Garonne. It is planned to place F4 in service in 1990.

7. Computer Science

This department continued modernization of its scientific computation facilities and, at the same time, major research work on parallel computing and artificial intelligence.

Scientific Computers

An accelerated program for installation of workstations and minicomputers was prepared concurrently with development of the Ethernet communication network.

In addition, it was decided to replace the Cray XMP 18 placed in operation in June 1987 by a Cray XMP 416 which should be operational in July 1989.

Parallel Computing

1988 was marked by the start of operation of a Hypercube with 32 nodes. This experimental facility interests several outside organizations, in particular CEA [Atomic Energy Commission].

Artificial Intelligence

Among the current applications can be mentioned the automatic Cray operator control system and an intelligent interface demonstrator for use of a 3D incompressible flow computation code.

8. Systems

Radars

The RIAS experimental radar antenna array located on the Isle of Levant was activated with two computers. One of these computers, produced by Thomson-CSF, provides surveillance of the airspace; the other, produced by ONERA, provides target tracking.

ONERA was awarded the contract as prime contractor of the Stratus radar analysis station, which will be installed on a French Navy ship at the end of 1990 for long-range target observation.

Space

ONERA is also preparing the future with its research on the restitution of satellite orbits for navigation and for developing a space surveillance station with adaptive optics. For the first time in Europe, a laboratory experiment associating adaptive optics with a wave surface analyzer allowed real-time correction of ambient turbulence.

9. International Activity

Earlier Cooperation

These efforts were actively continued: bilateral with the USA (US Air Force and Navy, NASA), the United Kingdom, West Germany (DFVLR [German R&D Institute for Space Travel]), multilateral in the framework of the GARTEUR and the AGARD [expansions unknown].

Cooperation with China was also very active, in particular with the CAE [Public Authorities and Business Council] in the area of axial compressors and materials. Work on the Chinon compressor continued.

Japan, in particular NAL [expansion unknown], is highly interested by our Modane wind tunnels and our work on ceramics and heat exchangers.

New Activities

1988 was a decisive year for the European transonic wind tunnel, with the creation of the company ETW GmbH by ONERA, DFVLR, NLR [Netherlands Aerospace Laboratory] and the Ministry of Defense of the United Kingdom (start of testing planned for 1994).

Other major cooperation actions were decided on, in particular a program of aeronautic research in the BRITE/EURAM framework (until now called Euromart) which will be managed by the European Community agencies. This pilot program, with a duration of two years, will be funded with 50 to 60 million ECU's and will allow studies proposed by several European aeronautic industrialists to be initiated in association with research organizations such as ONERA.

Views Differ Sharply on New Hermes Design

Hermes Program in Trouble

36980148 Rotterdam NRC HANDELSBLAD in Dutch
28 Feb 89 supplement p 4

[Article by Sjoerd van der Werf: "European Space Shuttle Remains Doubtful Entity—Lighter, Smaller, with Fewer Tasks and Hardly any Transportation Capacity"]

[Text] Hermes, the small European space craft under development is beginning to look more and more like a chameleon. New concepts are presented on the average of once every 6 months. Lately, version SMX-C has been the favorite, but nothing is really very firm yet. It is not beyond imagination that a number of different concepts

will come under review even after April, when the "definitive" plans will be officially transferred to the European space travel organization ESA [European Space Agency].

The Hermes project is one of the most important West European space travel programs, together with the Columbus space station (which will be part of the international, but still primarily American space station "Freedom"), the independently functioning European MTFF space lab (MTFF stands for Man-Tended Free Flyer) and the Ariane-5 super-rocket. While the development of Columbus and Ariane-5 is proceeding according to plan, there is always something wrong with Hermes. And this involves more than just matters of detail.

One of the latest unpleasant surprises for the designers was the discovery that the aerodynamic characteristics of the space craft were such that it is virtually certain that, with a three man crew and maximum return cargo, the craft would burn up returning to earth because the frictional heat would not be adequately absorbed. According to Patrick Eymar, head of the Department for Advanced Space Travel Systems of the French Aerospatiale corporation, it basically came down to the fact that "the wings were not large enough to carry the full weight." "Hermes would not soar back to earth, but fall like a brick," said Eymar.

Smaller

It would be relatively simple to solve the problem with a broader wing surface, if it were not for the fact that larger wings would add so much weight to Hermes that the Ariane-5 rocket would no longer be strong enough to launch the craft into an orbit around the earth. And since, in the current planning, the capacity of the Ariane has already been pushed to the highest limit it was at long last decided to be content with a smaller Hermes, which also implied that its relatively larger wings would start at the nose section. More than a year ago, the craft's length was still 15.5 meters; in the latest concept it is only 13.1 meters long. And to think that the length foreseen in the original plans was 17 meters!

The latest changes represent a serious attack on the already sharply reduced cargo capacity of the Hermes. At one time, the craft was intended as a kind of space centipede with an extremely varied task package: shuttling astronauts (maximum six) and a 5 ton cargo between earth and a space station, putting satellites in place, maintaining and repairing space vehicles in an orbit around the earth, long term missions (up to approximately 30 days) for observation of the surface of the earth and equipment experiments, space hauling and potential rescue operations.

This dream has long since become past tense. What remains is a mini-space ferry, which can transport a maximum of three people, put a 3 ton cargo into space, and carry only a cargo of 580 kilograms on its return flight.

Cargo Space

By far the most significant change in the concept is the role to be played by the so-called adapter—the segment which connects the stern of the Hermes with the upper level of the Ariane-5 rocket. In contrast to the original plans, this part, which is referred to as "Module de Resources Hermes" [Hermes Resource Module] (MRH), remains attached to the craft during flight and is jettisoned only shortly before the return to earth.

The intent is that at the time of launching the heaviest cargo will be in the MRH and from there could be transferred to a space station. But because the "back side" of the Hermes must be coupled to the Columbus or the MTFF, the air lock which runs from the steering cabin through the whole craft will also be run via the MRH and thus acquire greater length.

That is in and of itself not all that grave, but the fact that each time at the end of a mission the adapter with lock and coupling systems will have to be jettisoned, will burn up in the atmosphere, and thus will have to be replaced for each successive flight with a completely new package, can hardly be considered an efficient and economically responsible solution to the weight problems. In addition, the lock is becoming so "tortuous" that it probably will no longer be usable to provide access to the NASA standard measurement regulated instrument racks for the Columbus.

Rescue Systems

The problems related to the weight of the Hermes were caused by the decision to build in an escape system for the crew weighing approximately 2.5 tons. That decision was made following the American Challenger disaster. In case of an emergency, the pressure cabin must be shot out of the craft during the first phase of the launch (up to a height of 60 kilometers) in order to return to earth with the help of two large parachutes.

But several European space travel experts are not convinced that this rescue system, comparable to that of the American B-1 bomber, would increase safety all that much. Even project manager Christoph Hohage of the West German MBB [Messerschmitt-Boelkow-Blohm] company, which is in charge of the rescue cabin, has doubts.

Robot Arm

Meanwhile, the constant changes in the concept also have consequences for the HERA robot arm, with which the Hermes is to be equipped. This HERA, which the Fokker company plays a very important role in developing, will no longer be part of the Hermes instrument package, but will be given a place on the MTFF, Europe's autonomous space station. However, the HERA—which is smaller and lighter than the robot arm of the American

Space Shuttle, but would nevertheless according to calculations be capable of handling heavier cargos with greater accuracy—will be transported by the Hermes. According to plan, the Hermes (unmanned) will be launched for the first time in April 1997. But virtually nobody attaches any value to this schedule anymore. It will probably turn out to be in the beginning of the next century. And there are experts—even within European space travel circles—who are wondering whether the craft will ever rise beyond the stage of doubtful entity.

Hermes Gets New Look

36980149 Brussels *LA LIBRE BELGIQUE* in French
13 Feb 89 p 9

[Article by special correspondent Paul Dominique: "The New Face of the European Space Vehicle"]

[Text] Hermes, whose first flight has been set for April 1997, is changing its looks.

For several months now, an "integrated" team of some 80 engineers has been working in Toulouse to refine the definition of the European space vehicle Hermes.

Both its exterior shape and its interior design have evolved in response to the constraints imposed by the launcher (Ariane-5), the conditions for reentry into the atmosphere, the ejection system for astronauts in case of an emergency, and the need for Hermes to be able to dock to various orbiting stations.

Description

Taking those constraints into consideration has contributed to an optimization of the very concept of the Hermes.

A truncated adapter, the "Hermes Resource Module," the MRH, located at the back, will serve as propulsion compartment and will contain non-pressurized elements of the payload. It will also house the docking system. This structure will remain attached to the Hermes during the whole orbital period and will be jettisoned following the maneuvers which will separate the space vehicle from its orbit, moments before its reentry onto the earth. This will make it possible to reduce the reentry mass, given that mass problems are at least as critical at the time of reentry as at the time of the launch.

Hence, the resource module will be "disposable" and prior to its separation the astronauts will fill it with all the objects they do not need to bring back to earth, specifically empty containers and vessels.

On the inside of the vehicle, the hold will be closed and pressurized, while the radiators will be placed on the outside of the MRH. The three astronauts will have at least 8 cubic meters of living space in the hold, in addition to the 4 cubic meters in their cabin. The 3 tons of pay load which Hermes must carry along will be stored

partly in the pressurized hold where they will take up 16 cubic meters. Studies have revealed that some pay loads, specifically equipment to be attached to the exterior of orbital stations, will be more comfortably stored in a non-pressurized environment. Thus, they will be placed in the rear of the MRH. Only half of the pay load (approximately 1.5 tons) will be brought back to earth.

Two Flights Per Year

The astronauts will have access to the orbital stations through a lock chamber, which will also allow them to carry out activities outside the vehicle. The craft's docking piece will be located at the rear. Its 1.27 meter diameter will be compatible both with the "Freedom," the international station (with American majority), the Man-Tended Free Flyer, the MTFF of the European Columbus program, and possibly other stations such as the Soviet MIR vessel.

It is expected that the Hermes will remain in space for up to 12 days, one week of which it will be docked to the MTFF. The experts anticipate two flights per year for the servicing of this accessible minestation, as microgravity experiments must be changed every 6 months by the Hermes astronauts, who will also be able to carry out the necessary repairs and refuelings.

However, it is not expected that these astronauts will often step out into the space void. For most of the outside work, they will have a remote manipulator arm adaptable to both the Hermes and the MTFF and which should remain in space.

Flight Safety

The crew ejection system in case of emergency is still under study.

This is a complex problem because it must be reliable and respond to the harsh conditions of the flight. It must be possible to eject the cabin during the period when the solid propellant modules are in operation, that is to say during the first 120 seconds of the launch. This phase of the flight which starts at zero speed, culminates at Mach 7.

Following this period it is no longer the cabin but the whole craft which will be able to detach itself from the Ariane-5 launcher in case of emergency. It will return to earth in gliding flight. Thus, the engineers in Toulouse are currently working on the cabin and are moving toward the concept of an ejectable nose in the plane's shaft.

Several technologies critical to the European space ship still remain to be developed, specifically the thermic protection equipment and the energy generating systems. Other technological challenges will also have to be taken up: the aerodynamic and aerothermic systems, especially

in the areas of high Machs and weak pressures, advanced "spacionics" with numerical transmissions by bus, flat screens and sophisticated software, robotics and the life support system.

Program

The director of the Hermes program at Aerospatiale, the French company which is the chief architect of its construction, expects that the definition of the Hermes will be set by the end of the first semester of this year. This will make it possible to finalize the European industrial team through tenders before the end of the year.

The program must be definitely approved by the European ministers in 1990 and 2 years later the first development models and simulators will see the light. The integration of the two first planes will start in 1994 and 1995.

In order to qualify the automatic landing system and the approach procedures, subsonic flights are planned in Istres (France), starting in 1996 with the first Hermes 01 model. The first real launch, planned for April 1997 in Kourou (French Guyana) with the Hermes 02, will be a crewless flight and its goal will be the qualification of the aircraft as well as a checking of all the systems and auxiliary installations on the ground. One year later, the Hermes 01 model will be launched with a crew aboard, a mission which will include docking with the MTFF and probably activities outside the vehicle.

Hence, this major program is shaping up well. If the appearance of the aircraft has somewhat evolved, the mission remains unchanged and the significance of the Ariane-5/Hermes space transportation system is more attractive than ever. Hermes offers the Europeans access to inhabited orbital flights and the means for their independence in the exploitation of space toward the end of the century.

Restructuring of FRG's Aerospace Industry

Deutsche Aerospace
36980128 Munich INDUSTRIEMAGAZIN in German
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[Text] When the new aviation and aeronautics company Aerospace is founded sometime this spring at the latest, the period of probation will begin for Juergen Schrempp, the young head of this Daimler-Benz subsidiary. But before then his own bosses first must prepare the way.

For a long time Juergen E. Schrempp and Hanns Arnt Vogels knew each other only by hearsay. That is understandable: As a member of the Daimler-Benz AG managing board, Schrempp (44) moved with his trucks on terra firma, whereas Hanns Arnt Vogels (62), as chief of Messerschmitt-Boelkow-Blohm (MBB), moved far above the earth with his aircraft, rockets, and satellites.

It is only due to sheer accident that they once met at all—above the earth in an Air-France airplane that had taken off from New Delhi in the direction of Paris on 15 March 1988.

In any case, during the 9-hour flight the two at least became personally acquainted with one another and—over a glass of Moet Chandon—considered meeting again: "Do look me up sometime," said the older man jovially to his junior, "I would be happy to see you."

The invitation still stands; Schrempp will pay his visit quite soon. But by now Vogels' happiness in seeing him again may well have dimmed considerably: The young manager is coming not as a guest, but as his superior.

Because as of 1 January 1989 Schrempp becomes de facto the chairman of the managing board of Deutsche Aerospace AG, a Daimler company that is yet to be founded formally—and consequently the number-one leader of Dornier, the Motor and Turbine Union (MTU), the defense-engineering division of AEG [German General Electric Company], and soon also of MBB.

Thus, this adroit man of action is to occupy the most prominent position that has ever been available in the German aerospace industry. He has control over 70,000 employees, who will bring in a revenue of just under DM12 billion, and he will set the course for the second-most-important supporting leg of Daimler.

If hitherto nothing has happened in Germany's aerospace industry without Vogels—with DM6.1 billion in sales, MBB is the largest company in this field—now nothing will happen any more without Schrempp. Whether it is Airbus or Jaeger ["Fighter"] 90, antitank helicopters or seabed mines, whether Ariane, Hermes, or Columbus—in the future the young manager from Stuttgart will have the deciding word to say on all strategic questions in this industrial branch.

And then his appointment is also regarded as the most surprising item of top-personnel data in German industry within 1988. Daimler chief Edzard Reuter (60) did not bring to the fore any of the familiar names from the aviation and arms field, but instead a person largely unknown in this industry.

This is a lot of advance confidence in the young fast riser, because Schrempp's task is enormous. He must bundle up the four aerospace companies into a powerful bidder group while retaining their independence, he must closely coordinate their activities, must do away with excess capacities and duplication of work, and must unleash synergistic forces. When it has been thus consolidated nationally, Deutsche Aerospace is then supposed to assume a leading position internationally, and in Europe to "play equal fiddle" (Schrempp) with British Aerospace and France's Aerospatiale.

The newcomer is not bringing with him any special technical qualifications for this "Herculean labor" (Reuter). In his 26 years at Daimler-Benz, Schrempp has won his laurels primarily in the truck business, which has been characterized by global excess capacities and price wars.

The toughness of this job has molded him: Hard-working, decisive, success-obsessed, and without the impression of marble coldness that managers at this level in a firm's hierarchy usually give, he himself has successfully handled the most difficult of situations.

He brilliantly restored to health not only the Daimler subsidiary in South Africa but also the heavy-duty road vehicle builder Euclid in Ohio. He was decisively involved in organizing Daimler's commercial-vehicle construction on a global basis and in introducing a production association around the globe. The fact that in Asia today the Stuttgart people are putting a wheel to the ground at all with their trucks, vans, and buses against the predominance of the Japanese there can be credited to him as one of his successes, along with the financial turnaround of the entire commercial-vehicle division: For the first time in a period of over 10 years, Schrempp and his colleague on the managing board, Helmut Werner, are again bringing money into the concern's coffers—at a level of DM400 million, far more than anticipated in the internal plans.

At all events the former Daimler trainee is approved of in the trucker business. His employees even call him a "regular guy," which in Swabian is a high distinction. He himself is more modest, is just glad that despite his rapid rise he has remained the same as ever—"down to earth."

He has not in fact become airborne in his straight run to the top. Even as a Daimler manager he sometimes plays a trumpet in hotel bars in emulation of his great idol, Louis "Satchmo" Armstrong, or sings into the microphone "Love Me Tender"—in an absolutely professional manner. And then if after such a surprising interlude the amazed employees or management colleagues give him standing applause, he enjoys the ovations—knowing that once again he has gained all along the line.

The Star Will Be Reserved for the Automobiles

Schrempp's abilities to think strategically, to keep a cool head in critical situations, to find solutions and also to implement them, as well as to remain courteous and charming throughout were probably also the factors that moved Reuter to entrust him with Daimler's greatest challenge to date.

In any case on 30 October, at his home, the chief of Daimler told Schrempp what his duty was to be. Two days later, on All Saints' Day, the spectacular personnel deal was hammered out with Reuter's second-in-command, Professor Werner Niefer—he is to become

chief of the outside board of directors of Aerospace—which made it possible for the final okay to then be given by the highest Daimler supervisor, financier Dr Alfred Herrhausen.

Meanwhile the managing board of Aerospace AG is as follows: Schrempp's deputy will be Johann Schaeffler, who will simultaneously remain head of Dornier. Responsibility for international marketing and cooperation will be given to the head of Daimler-Benz's Munich branch, Karl Dersch. In addition to Schaeffler, the chiefs of the other three companies will also be members of the management body. These are Hanns Arnt Vogels for MBB (until the end of 1989), Dr Hans Dinger for MTU (unless for health reasons he steps down from his office), and Hans Gissel for the divisions of high-frequency engineering and naval and special engineering that are to be separated off from AEG.

It is unlikely that the newly formed managerial team will be able to attend to its job in an exclusively technocratic way. Because ever since the discussion on an association with MBB, not only have the Daimlers been fired up by the prospect of involvement in some leading technology but also have been confronted, as it were, with an image-damaging "debate about a concern with an arms-company orientation." In any case, with the formation of an independent Mercedes-Benz AG—for which alone will the "star" trademark continue to be reserved—this concern is making it clear that through this discussion it does not want damage to come to its paramount business pillar, auto-making (75 percent of the concern's sales of DM73 billion inclusive of MBB, and 90 percent of the total profits).

Therefore Schrempp and his men will necessarily have to also get involved in an aggressive way in this dispute in order to keep the overall enterprise of Daimler-Benz from having its body-paint scratched at its most sensitive spot—a "labor of Hercules" also in the political-psychological field.

But that is only one of the fronts. Defensive action must also be waged against the avowed partisans of a market economy and guardians of free competition within the republic. Even though FDP head Otto Graf Lambsdorff has finally given in, by no means has he thereby abandoned his "regulative-policy reservations" about the MBB takeover. The debate is not over yet: Professor Ulrich Immenga, chairman of the monopoly commission, intends to step down from his office if there is such a merger—a "hard nut to crack" for cartels office president Professor Wolfgang Kartte, comparable to the "Tempter" of the Catholics (FDP deputy Detlef Kleinert).

The critics of this "regulative-policy Temptation" are absolutely right; except that they overlook a quite decisive consideration: For a fairly long time now a situation of classical competition in this industry has no longer existed. Long ago the French and British imposed a

division of labor on their respective firms in the aerospace industry and thus separated them from a relationship of national competition. For example, in France guided missiles are being built only by Matra (private company), combat aircraft only by Dassault (government-controlled), civilian aircraft and rockets only by Aerospatiale (state-owned company). Under these conditions, national bidding competitions are meaningless.

But the policy of the division of labor among the European partners also delimits the decision arrived at by the Germans in connection with international projects—and that is by far the predominant portion in this industry. Dornier head Johann Schaeffler had to suffer through this painful experience once again just a few weeks ago.

Bonn's defense ministry had invited bids nationwide for the development and construction of a reconnaissance drone (DM500 million), in connection with which Dornier gave a lower bid than its competitor MBB. But while the competition process was still going on the Hardthoehe [German pentagon] decided to make common cause with the French on this project, for purposes of lowering costs. With that, Dornier was automatically out of the running. Because in France drones are built only by Matra, which in turn has an agreement of cooperation with MBB.

This example emphatically shows: Despite the situation of national competition in the FRG and despite an invitation for bids made by the Hardthoehe, when international projects are involved the German contracting authority has lost control over how the competition is to turn out.

"The next time," angrily blustered Dornier chief Schaeffler at Manfred Timmermann, state secretary for defense, "I will send you the yellow pages."

In the opinion of Schaeffler a structural simplification of the FRG's aerospace industry is urgently necessary for the reason that the FRG is no longer a market by itself but only a "subset of the European market." A "fictitious national competition" leads only to a "weakening of our industrial competitiveness on the European level."

Division of Labor Also on the European Level

That is, so long as Dornier and Messerschmitt-Boelkow-Blohm compete for public morsels, not only will neither of them have enough to eat but also each will fall behind vis-a-vis their European competitors. Both companies have to hold personnel available for potential orders that only one of them will receive. And also parallel developments at Dornier and MBB are unnecessarily costly, which in turn weakens both companies vis-a-vis their competitors in France, England, Italy, and Spain.

Worse yet: With their diversity of bids the Germans are also losing out technologically. With the Jaeger 90 combat aircraft, for example—even though this was essentially conceived by MBB—the two German firms will merely build the fuselage midsection and the rudder unit, concern themselves with the hydraulics and landing gear, and supply the main gun of the Tornado, which by now is 15 years old.

In contrast, British Aerospace was able to get for itself the technically most sophisticated portions of the program; it will build the forward airplane portion together with the electronically elaborate cockpit.

For the Hardthoehe this unequal distribution of tasks is not an issue. But it goes completely against the grain of economics minister Martin Bangemann (FD). At the cabinet table he raved: "Whereas the French and British aerospace industries have been able to secure key technologies for themselves, so far the German companies—despite large subsidies—have only been able to win for themselves technologies that for the most part are considerably less interesting."

And what is true of Germany will soon apply to Europe itself. The multiplicity of competing products by various European firms that currently still exists can scarcely be sustained in view of certain economic considerations.

Even now, says Schaeffler in reference to what he sees as unavoidable, we cannot really afford three different innovations in combat aircraft (Jaeger 90, the French Rafale, the Swedish Gripen), two different new developments for antitank helicopters (the German-French PAH 2, the Italian A 129), and three new 60-seat to 70-seat intermediate-range commercial aircraft (British ATP, Dutch Fokker 50, the French-Italian ATR 72). "If nevertheless we do these things, we will be hastening a development at the end of which Europe will have to bid farewell to such product lines."

Thus for Schaeffler a division of labor is also urgently required on the European level as well. Since the Germans are not allowed to have any jurisdiction in arms exports—the military weapons control law stands in the way of this for the most part—and the French dominate the civilian aircraft program of Airbus, the Germans are left more or less with a specialization in reconnaissance systems, a niche in which they are already a leader today, with radar, drones, guided missiles, and the like. Moreover this field also has the political advantage that it is not affected by additional disarmament efforts. On the contrary: The more disarmament there is, the more military reconnaissance becomes necessary.

After all the concentration of German activities within the Aerospace AG is not primarily aimed so much at entering into the European competition. Rather, as Schaeffler admits candidly, it is a matter "of focusing

this industry on a European level, so that we will give ourselves the chance in the future to compete with the United States and the USSR in global competition."

How difficult such a pan-European tailoring will be is impressively demonstrated by the Airbus project, for the sake of which, in fact, Bonn has pursued this liaison between Daimler and MBB so doggedly. To be sure, Daimler chief Reuter gives the Airbus a chance of having economic success if some day there should be a European law on companies. But even if this becomes a reality some day and Airbus Industrie in Toulouse were to be given the responsibility for procurement, logistics, and production of the plane in addition to the marketing responsibility, success would by no means be automatically ensured because of extremely uncertain currency movements.

Moreover it is also unclear who is to make available to this company the necessary capital of about DM12 billion. The non-cash capital contributions that are to come in would add to the balance a sum of at most DM1.5 billion, and the remainder is not likely to be made up for by loans alone. These unanswered questions about the future will have to be confronted someday—already the rearranging of the German part in the Airbus orchestra is giving those responsible a severe headache.

The intended separating off from MBB of the Airbus production, which after the Daimler takeover is to be managed as an independent company—German Aircraft Company (DFG)—(MBB to have an 80-percent interest, government interest of 20 percent via the Reconstruction Loan Corporation) requires a capitalization of about DM4 billion. But the non-cash capital contributions add up to just DM0.5 billion. Although the Daimler payment of DM800 million for a 30-percent share in MBB is to go directly to the DFG (with interest added on, this sum increases to DM1.2 billion by 1994), in any case more than DM2 billion still has to be found on the capital market. Without a federal guarantee, it will be hard to get so much as a single mark on that market.

Therefore Reuter has been adamant about not taking over the federal government's shares in the DFG until the year 2000 rather than already in 1994, as Finance Minister Gerhard Stoltenberg would have liked to see happen. But even thereafter it is likely that Bonn will be reminded of its financial responsibility for the Airbus if movements of the dollar or trade-policy sanctions by the Americans threaten the existence of the DFG and thus the MBB. Therefore Daimler wants to know right today "how MBB as an 80-percent shareholder can free itself from a loss responsibility for the Airbus not only legally, but also practically and without losing in reputation" (according to an internal Daimler paper).

But first the Stuttgart people must pull off the MBB deal with the utmost dispatch. Because the Federal Government will release its promised Airbus funds for 1988 only when the merger contracts are signed and sealed—

that is, the threat of bankruptcy will be hanging over the head of the MBB subsidiary Deutsche Airbus GmbH (which is where the annual losses are mounting up) if there is further delay. Daimler must come to a definitive settlement by the date of the balance-sheet certification in March at the latest, because bankruptcy of the Deutsche Airbus GmbH would also put MBB in a tight spot: The loans guaranteed by the Federal Government are counter-guaranteed by this aerospace concern at the 25-percent level. Inclusive of the prepayments for the development of the A330/340—this money also will be flowing in only after the signing of the agreement—for the Munich company this amounts to the princely sum of DM0.5 billion.

Accordingly the pressure to rapidly settle the terms of the MBB association is equally great on all participants. On 21 December Reuter will present to his board of directors a "letter of intent," according to which Daimler-Benz will pay DM800 million for the increase of capital stock by 30 percent at MBB, and DM600 million for the option on another 21 percent. Small shareholders such as Dr Ludwig Boelkow (with 1 percent) and the Blohm family (0.68 percent) are ready to sell equally with the VFW [United Aeronautical Works] managing company (10 percent, it belongs to Vulkan of Bremen and to the Senat-owned Hibeg) and the BD-Industrie affiliate (10 percent, it belongs to the Bavarian Association Bank and to the Dresden Bank). Thus it is likely that the merger will have been wrapped up by the spring at the latest—for Reuter and his second-in-command Niefer, still a negotiating marathon that leaves them scarcely any time for problems of the concern elsewhere.

But then it will be Schrempp's turn. His success will be dependent also on how soft the bed is that is prepared for him by his two negotiation strategists from the Daimler leadership. But the recently chosen aerospace leader knows that even under the most auspicious conditions he is not likely to get to lie on down feathers.

Daimler-Benz Chief Interviewed
36980128 Munich *INDUSTRIEMAGAZIN* in German
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[Text] Daimler chief Edzard Reuter wants to have not only the say but also the bulk of the capital at MBB. He repudiates the criticism concentrated on him from Lambsdorff in one direction to the Greens in another.

INDUSTRIEMAGAZIN: Mr Reuter, by now the federal cabinet and the board of directors of Daimler-Benz have given the green light for the association with Messerschmitt-Boelkow-Blohm (MBB). Will you now be able to keep to your schedule of having the partnership contracts signed and sealed by the end of the year?

Edzard Reuter: We sincerely hope that this will be possible, because before the end of 1988 we are required to submit the final contractual terms to our board of directors for its approval. Incidentally we believe that it

is in the interests of both our company and MBB to now quickly come to a final decision. Because the continuation of public discussion would not be helpful to anyone.

INDUSTRIEMAGAZIN: Then where are there hurdles that you still have to clear away?

Edzard Reuter: Of course we still have to discuss the details of the arrangement that the Federal Government has proposed to us. That is one aspect. The important other aspect concerns the negotiations with the shareholders of MBB. Of course, these negotiations should be such as to enable us to participate in MBB at 30 percent and to be given an option on 51 percent. These talks have not been concluded by any means.

INDUSTRIEMAGAZIN: Do you have to conduct these negotiations with each separate shareholder?

Edzard Reuter: The chairman of the MBB board of directors had already assumed the task beforehand of arranging for a coordinated stand among the shareholders. And he will also keep this mandate until the conclusion of the negotiations. Moreover we will talk in detail, of course, to one or another shareholder about our views if he should have a need for clarifications. But we can conduct the negotiations proper only with all shareholders jointly.

INDUSTRIEMAGAZIN: You talk about a 30-percent involvement in MBB with an option on 51 percent. So is it not likely that the "need for clarifications" with one or another shareholder will still be very great?

Edzard Reuter: Yes, of course. But I do not see any more insurmountable hurdles.

INDUSTRIEMAGAZIN: But your commitment with MBB makes sense only if you actually possess 51 percent of the company's capital?

Edzard Reuter: We have always said that the manageability of the undertaking is the necessary condition for our participation. The question of a minimum possible majority interest plays an important role here.

INDUSTRIEMAGAZIN: Have you set yourself a time limit for when you want to have the majority?

Edzard Reuter: At present this question concerns us less than it would seem at first. If there is agreement on where the leadership decisions are ultimately made, it is no longer so important to also have 51 percent formally in one's own portfolio. In any case, to be able to say where things are going to be heading is what is most important for the time being. Independently of this, we are also eager to obtain the majority in actual fact, of course.

INDUSTRIEMAGAZIN: Mr Reuter, regardless of the Federal Government's position a supercoalition made up of CDU, FDP, SPD, and Green party members is opposed to your involvement with MBB. And even the employees' representatives on your board of directors voted "no" in the decisive vote. Given this concentrated assemblage of avowed opponents, are you still feeling comfortable?

Edzard Reuter: The chairman of the board of directors, Dr Herrhausen, and I myself have said on this that we take seriously the arguments that have been expressed against such a commitment, so long as they are not of a purely polemic nature. This does not absolve us from having to take action: On the one hand from the viewpoint of our civic responsibility, and on the other from the viewpoint of our company. In both cases there is every reason for entering into this participation if it can be done on a sensible basis.

Incidentally, it is news to me that there is a large coalition with a composition such as you have described. Because my firm conviction is that those who understand and go along with this major step in the direction of a European industrial structure are clearly in the majority as much as ever.

INDUSTRIEMAGAZIN: Important political figures such as FDP chief Graf Lambsdorff or the Berlin senator for financial affairs, Elmar Pieroth (CDU), have definitely disagreed with this.

Edzard Reuter: I am quite confident that the gentlemen mentioned are amenable to arguments of fact.

INDUSTRIEMAGAZIN: Surely the doubts expressed about your commitment with MBB are being posed not only on regulative-policy grounds. Above all the resulting concentration of power is being criticized.

Edzard Reuter: Oh, you know, the most curious statements are being made here. It is being said, for example, that Daimler-Benz would have an unacceptably large share in the gross national product if the integration with MBB were to take place. In reality our share is now 1.5 percent—if we take as a basis the net product of our firm, and this is the only way it can be done. With MBB it would be 1.6 percent. It is beyond my comprehension why this small difference is now triggering a national discussion. But I can well understand that there is talk in general about the size of Daimler-Benz. But this has nothing to do with MBB.

Moreover, surely the national blinkers should be taken off once and for all. We are heading toward a Europe that will soon be a market amounting to 320 million inhabitants and thus will be larger than the United States. Against this background—compared, for example, to

General Motors but also to a fair number of other American companies—we will not really be an oversized company in Europe at all, even with the inclusion of MBB.

Further Development of Management Organization

INDUSTRIEMAGAZIN: Was then the expected association with MBB responsible for the fact that after only 2 years Daimler-Benz has changed its company structure once again?

Edzard Reuter: It is a wrong interpretation to say that we have had a new organization of management. This step that we now want to take is nothing more than a further development of the management organization in effect at present. Basically the new structure had already been set up in the management organization that we put into effect early in 1987. We are now only completing something that at that time had already been so intended.

INDUSTRIEMAGAZIN: But the holding-company structure now created would not then have been wrong 2 years ago?

Edzard Reuter: Of course not. But every organization of management must be introduced and set up in a manner tailor-made to the circumstances of a company. At that time, this step would have been too large and too radical.

INDUSTRIEMAGAZIN: You will be putting three companies under the holding-company roof: Mercedes-Benz AG, AEG AG, and Deutsche Aerospace AG. In the specific case of Aerospace, how is control to be ensured?

Edzard Reuter: According to our conception, the three product-division companies—that is, Mercedes-Benz AG, Deutsche Aerospace AG, and the AEG AG—will be associated in each case via company-interlinking contracts with Daimler-Benz AG, namely the holding company. Company-interlinking contracts are nothing else than control contracts. Accordingly Daimler-Benz will have the right to give instructions to these product-division companies. Now of course it should not do this in terms of operations. But with regard to the strategy of the overall concern, the final decision lies with the holding company. Another good reason for this is because we of course are keeping as much as ever to the objective of being an integrated technology concern—an objective that we have already realized now in a number of sectors.

INDUSTRIEMAGAZIN: And Aerospace in turn will then conclude control contracts likewise with the companies MTU, Dornier, AEG-Defense and soon MBB?

Edzard Reuter: On that we have not yet come to any final decision.

INDUSTRIEMAGAZIN: But surely such a step would be logical and consistent?

Edzard Reuter: Yes, certainly this has not been ruled out. But right now this question is not of central concern.

INDUSTRIEMAGAZIN: Are still unresolved problems of final settlements hindering you in this?

Edzard Reuter: No, it is instead a question of practicality.

INDUSTRIEMAGAZIN: When you separate off the defense-engineering sectors at AEG along with DM2.1 billion in sales and run them as an independent firm, surely you have to think about a loss compensation for the outside AEG shareholders?

Edzard Reuter: Not in the sense that something must be distributed to the outside shareholders here. There are two possibilities: Either the AEG will receive a fair purchase price or an appropriate interest in Aerospace in return for the sectors that are to be separated off. Or else the components will be turned over at their material value and invested there at an interest rate corresponding to the current rate of return. In neither case is there any associated damage to AEG shareholders.

INDUSTRIEMAGAZIN: Which alternative do you prefer?

Edzard Reuter: We are currently thinking this over very carefully.

INDUSTRIEMAGAZIN: By now the first personnel-policy decisions have also been made, with the appointment of Mr Schrempp as chairman of the managing board of Aerospace probably being the greatest surprise. Now what is there to be said in favor of Mr Schrempp, who up to now has not exactly received his laurels in the field of aerospace?

Edzard Reuter: Everything speaks in favor of Mr Schrempp. He is an excellent manager, and quite soon all parties concerned will learn how correct this decision is.

INDUSTRIEMAGAZIN: It has also been decided that Mr Schaeffler, managing-board chairman at Dornier, is to become the deputy Aerospace chief. After the MBB takeover will he also be sitting in the chief's armchair there?

Edzard Reuter: These are speculations on which I do not wish to comment right now. We should patiently wait for the decisions that are to be made here. Incidentally, at present MBB is being run superbly by Dr Vogels.

INDUSTRIEMAGAZIN: According to the Corporations Law, Aerospace will also have a board of directors with co-management. Have you already been looking around for a chairman of this body?

Edzard Reuter: Quite certainly the relevant chairman of the board of directors of the three company divisions will be a member of the managing board of Daimler-Benz AG

INDUSTRIEMAGAZIN: Mr Reuter, what strategic goal must Aerospace aim at?

Edzard Reuter: First of all Aerospace must develop into an intrinsically homogeneous group of German firms in the area of aerospace and defense engineering. This alone is already an enormous task. The second of its goals is to achieve—within the context of international cooperative ventures—a competitive capacity on a global scale.

INDUSTRIEMAGAZIN: With whom do you want to cooperate in international circles?

Edzard Reuter: I will not disclose this to you at present, especially since this is not a decision for me to make alone. The question will be clarified in cooperation with the new Aerospace team.

INDUSTRIEMAGAZIN: But your preferences lie in Europe?

Edzard Reuter: For many reasons they lie in Europe, but they are not directed at anyone in particular. They may certainly also be of a transatlantic nature, and for that matter they may also be directed towards the Far East.

INDUSTRIEMAGAZIN: You will be carrying over the Airbus financing problem into the MBB subsidiary German Aircraft Company yet to be established, in which the Federal Government will have a 20-percent share and MBB an 80-percent share. Now if in the year 2000 the Federal Government no longer goes along, does the risk then fall entirely on you?

Edzard Reuter: As the Federal Government resolved in cabinet session, the objective is a gradual privatization of the Airbus activities. We are prepared to assume additional risks, provided that this is responsible in terms of private enterprise. The present viewpoint is that the joint objective should be to create by 2000 the prerequisites for running the Airbus company on a private-enterprise basis.

INDUSTRIEMAGAZIN: And if this does not succeed?

Edzard Reuter: I am optimistic that we will pull this off.

INDUSTRIEMAGAZIN: If the risk is going to be too big, do you have a means of bailing out?

Edzard Reuter: The issue here is not a means of bailing out. It has been agreed with the Federal Government that there must be joint discussions about the basic courses to be set. This means, for example, that it is

obliged to contribute to creating a European law on companies. Without a European company law there also cannot be any European private-enterprise company.

INDUSTRIEMAGAZIN: Do you then seriously believe that some day it will be possible to make money with civilian aircraft construction in Europe?

Edzard Reuter: I am firmly convinced of this.

INDUSTRIEMAGAZIN: Is it not rather the case that you see chances for growth in the defense-industry sector and can anticipate profits here, whereas aircraft construction will not be very attractive in the future as well, at least financially?

Edzard Reuter: In light of the demand for civilian aircraft that is now finding expression already in the order books of the Airbus industry, it will be possible to put this sector on a sound basis. To be sure, a good deal of Herculean labor is still required for this, that I know well. But I am convinced that it can be a lucrative business activity, and without the military sector having to subsidize the civilian one. However at the moment—and this is not disputed—this prerequisite is not yet present.

INDUSTRIEMAGAZIN: Mr Reuter, does it bother you when meanwhile the label of arms concern is thrown in your face?

Edzard Reuter: Actually that bothers me only because of the choice of words. Because in the German language the word "arms" [Ruestung] has the unpleasant hint of "rearming" [Aufruestung]. And that is simply the reverse of what we want. We stand by the view that we are employed in the sector of defense technology. We are part of a defensive alliance, NATO, and each year tens of thousands of our young men are called up into military service, and of course these must also be outfitted with suitable equipment.

On the other hand we entirely stand by the objective of disarmament and will also support every step that leads to further disarmament. After all, the more disarmament there is the more expanded is the scope for relevant civilian activities.

Rise to One of Top Three—Comparison of the Aerospace and Defense Companies in Europe.

Company	Sales in Billions of Marks (1987)
British Aerospace, Great Britain	12
Rolls-Royce, Great Britain	6
Aerospatiale plus Dassault ¹⁾ , France	12
—Aerospatiale	7.5

—Dassault	4.5
SNECMA, France	3
Matra, France	2
Daimler-Benz-Aerospace ²⁾ plus MBB, Germany	10.7
—Daimler-Benz-Aerospace	5
—MBB	5.7
Airitalia	2.1
Fokker, Netherlands	1.8
CASA, Spain	1

¹⁾French state owns 100 percent of Aerospatiale, only 45.8 percent of Dassault. But the state has 55 percent of the Dassault voting rights and thus also has control over this aerospace company. ²⁾Daimler-Benz-Aerospace includes Dornier, MTU, and the AEG divisions A1 (high-frequency engineering) and A4 (naval and special engineering).

Goals of FRG Space Agencies DARA, DFVLR in Conflict

36980130c Stuttgart *FLUG REVUE* in German
Jan 89 p 45

[Text] A willingness to compromise is needed on the part of DFVLR with respect to DARA [German Space Agency]. Now there are fears of a cutback in resources for space research.

"We do not want DFVLR's contributions to get lost in the shuffle," said the chairman of the board of directors of the German Research and Experimental Institute for Aeronautics and Astronautics (DFVLR), Prof Walter Kroell, voicing his fears at the annual board meeting of the major research institution in Goettingen. After the announced reduction in funding for space research by the Federal Ministry for Research & Technology (BMFT), he considers a further weeding out of existing programs—especially in the space sector—untenable. Kroell was thus indirectly responding to criticism of DFVLR to the effect that the institute has been unable to properly deploy its resources. "Whoever wants more has to make additional funding available or tell us which activities we can shut down in consultation with our partners," he explained. "We need additional resources from the major national and European programs in order to supplement our own fundamentally financed achievements with the expected supercritical results."

The renaming of the "five-consonant firm," DFVLR, to DLR [German Aerospace Research Institute] is also intended to signal a new beginning. However, the board of directors is expecting a great deal more from the establishment of a capacity for systems analysis than from the new nomenclature. This capability should allow the institute to use analyses of the field to define objectives for its own activities and to provide recommendations for decision-makers, as well as for the professional world and the general public.

Management Services for Other Areas

In the area of space, this realization has come too late. There, these tasks will be largely performed by the new national space agency, DARA, which is scheduled to be set up shortly. Still, the danger that DARA might control DLR operational facilities—such as the space control center in Oberpfaffenhofen—has reportedly been averted. According to Kroell, DARA and DLR will function side by side: "One with national management facilities, the other as a research and operational facility." In the future, however, the two agencies will have to do part of their work together, in close consultation and cooperation. "Basic principles are being drawn up in writing for this," stressed the DLR board chairman.

Those DLR employees who do not move to DARA will supposedly use their space management experience in other areas as well, such as in aviation or energy technology. The DLR board has thus decided to establish a "management services" facility, seeing to tasks that in terms of content, size and length cannot be covered within the usual spectrum of responsibilities of an institute or other facility.

Second FRG Spacelab Mission Slated for 1991

36980134a Frankfurt/Main *FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT* in
German 9 Jan 89 p 8

[Article: "Spacelab To Be Launched Again in 1991"]

[Text] Bonn/Bremen—The second German mission of the European Spacelab will be launched at the end of 1991, according to reports from MBB [Messerschmitt-Boelkow-Blohm]-Erno in Bremen. The Federal Ministry of Research is reported to have taken a significant step for its realization by authorizing phase I of the system contract for the D2 mission. Following the explosion of the American shuttle "Challenger", another Spacelab launch at first seemed to be far in the future. In late fall of 1985, astronauts Reinhard Furrer and Ernst Messerschmid were launched on the D1 mission.

The major tasks required from MBB-Erno within the framework of the system contract are, among other things, analytical integration and systems technology as well as development and preparation of systems hardware and software and ground support equipment. Further tasks are payload integration and testing, preparation and support of launch pad activities, and ground support during the mission. In addition, support activities for D2 project management are provided for.

D2 and the related work serve to expand manned spaceflight in the FRG and purposeful preparation for use of the European part of the space station under German leadership. According to MBB-Erno, D2, along with the platforms Eureca, Amica, and other microgravity research missions, is thus an important step forward toward the European space station and platform program Columbus.

Status of FRG Participation in Ariane
36980134c Frankfurt/Main **FRANKFURTER**
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 12 Dec 88 p 8

[Article: "Large-Scale Production and Large Numbers of Launches Should Help Ariane Become Profitable"; first paragraph is **FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT** introduction]

[Text] Frankfurt—Status of German participation in Ariane development. Additional supplying countries penetrating the market.

The maiden flight of the large new Ariane-4 rocket, which placed three satellites in their planned earth orbits, was a great success. Through the year 2000, this "workhorse" of European spaceflight is to be launched at least 70 times and after recouping its high development costs might even turn a profit. Behind France with over 50 percent, Germany, with approximately 20 percent, bore the second largest share of the Ariane construction costs. Through 1995, with annual production of seven rockets, this will yield the German space industry a return on investment of approximately DM2 billion. The number of jobs in the Ariane project in the FRG is approaching 2000.

Ariane-4 is the highest performance version of the European launch rocket; it can, with various booster combinations, deliver payloads weighing from 1900 to 4200 kilograms into geostationary orbit. If need be, with special carrier systems, two or three satellites could even be transported simultaneously under the payload hatch. Thus, a favorable transport price per kilogram of payload is achieved which even sells international clients who want to have their satellites transported into earth orbit.

On the German side, it is primarily three large aeronautics and space companies that are involved in the construction of the European rocket Ariane: MBB-Erno in Munich and Bremen with 43 percent of German participation; MAN [Augsburg-Nuremberg Machine Works] in Augsburg with 42 percent, and Dornier in Friedrichshafen with 15 percent. Above all, the components of the second stage of the Ariane are being produced and integrated largely in Germany. The German Research and Experimental Institute for Aeronautics and Astronautics (DFVLR) has tested all of Ariane's engines at its power unit test facilities in Lampoldshausen.

With the various development packages, MBB-Erno received the largest orders for Ariane production outside France and is also a partner in the multilateral marketing company Arianespace with 8 percent of the share capital. Since the beginning of the Ariane project 15 years ago, MBB-Erno has been involved in development of certain components and in production and integration as well as qualification. This includes system leadership for the complete second stage and also manufacture of the

power unit for the high-energy third stage with combustion chamber, injection head, and expansion nozzle. This rocket engine operating with liquid hydrogen and oxygen presents special requirements in terms of quality and reliability.

In 1984, the space group at MBB-Erno also received the contract to produce the liquid rocket booster for the new Ariane-4 model, which is somewhat similar to Ariane's second stage. Because it is likely that 90 percent of Ariane-4's future launches will be equipped with this new booster rocket (2 or 4 each), series production of this system at MBB-Erno has risen to 24 units per year.

To curb prices, the multilateral company Arianespace has commissioned large-scale production of the European rocket beginning in 1991. Thus, 50 second stages and 50 power units for the third stage as well as 60 liquid boosters are to be commissioned for the Ariane-4. Added to this are telemetry systems for data communications during launch. MBB-Erno is not merely delivering the functional Ariane components to the launch pad at Kourou (South America) with a special freighter, the company is also heavily involved in the launch campaigns with a team of specialists who participate in three levels in the final tests immediately before firing.

MBB-Erno is also heavily involved in the development of the new large European Ariane-5 launcher. This aggregate with twice the launch force of Ariane-4 should be ready for use in the mid-1990's and, in addition to large, heavy satellites, is also supposed to carry the manned shuttle Hermes into earth orbit. Germany's largest space company will direct development of the cryogenic HM-60 power unit for the central stage of the Ariane-5. This unit runs on liquid hydrogen and oxygen and generates a 1000-kilonewton thrust. Its centerpiece is the design of the injection head, the combustion chamber, and the expansion nozzle; the development of the nozzle was awarded to the Swedish company Volvo.

At present, the emphasis is on the construction and qualification of the test facilities at the DFVLR in Lampoldshausen and at the French company SEP in Vernon. There are three different test devices for the turbopump, for the thrust chamber, and for the gas generator with the liquid oxygen pump of the HM-60 power unit called "Vulcan". The test runs have been performed in recent months. MBB is also heavily involved in the development of the L5 upper stage of the Ariane with a 20-kilonewton power unit. The injection head has already been successfully tested, and power unit runs with full-scale models have begun successfully in Lampoldshausen.

MAN Technology in Augsburg is likewise involved in production of important components of the Ariane-4 rocket. The company is supplying the turbopumps and gas generators for the four Viking power units of the first stage as well as for the one engine of the second stage.

Furthermore, MAN is building the structurally-integrated water tank for the gas generators as well as the thrust equipment for the first stage, with which the forces from the four power units are transferred to the structure of the entire rocket. For Ariane-4's liquid booster, the Augsburg company is supplying two lower and upper adapter structures, two turbopumps for the single Viking power unit, and two gas generators.

Even the highly traditional south German company Dornier has been involved in the Ariane project from the beginning and built the complete second stage tank for models 1 through 4, which was then connected at Erno in Bremen with the power unit and all other components. The tank consists of two fuel containers separated by a partition. The equipment includes measurement sensors, pressure delivery pipes, supply pipes to the power unit, so-called "slosh-attenuators", as well as filters and flexible bellows. The tank structure is made of an aluminum alloy joined using a special electron beam welding process. The quality of the seams between the cylinder segments and the hemispherical tank bases is monitored with x-rays. The entire structure is then age hardened at elevated temperature in an autoclave. This is followed by the insertion of internal equipment, finishing, and boring holes in the connecting flanges as well as measurement using special devices. After various leakage and pressure tests and interior fitting, the tank unit is filled with gas and readied for shipment.

Dornier will also be heavily involved in the production of the "large Ariane-5" planned for the 1990's. Its contributions are currently planned to be the 5.4-meter-diameter tank domes of the first stage as well as the satellite support structure Speltra which will accept two or even three satellites in the high-volume payload section. Dornier is already building new large fabrication buildings in Friedrichshafen on the Bodensee for these new tasks. Furthermore, the company is participating substantially in the marketing company Arianespace.

The development of the Ariane-4 rocket cost a total of approximately DM990 million, of which the FRG contributed 17.2 percent, or DM168 million. This total breaks down as follows among the contractors involved: MAN with 9.3 percent, or DM92 million; MBB-Erno with 7.6 percent, or DM75.2 million; Dornier with 1.7 percent, or DM16.8 million. German shareholders are participating at a rate of 19.6 percent in the international marketing company Arianespace, which has capital of DM120 million. These shareholders are the companies MBB-Erno, Dornier, Bayrische Vereinsbank, Dresdner Bank, Girozentrale, and WestDeutsche Landesbank.

The European marketing company Arianespace has been able to capture a 50-percent share of all satellite launches. This development was helped on the one hand by the American problems with the shuttle and "single-shot" rockets; on the other hand additional suppliers from the Soviet Union, China, and Japan have recently begun penetrating this lucrative market. Arianespace's

goal is to retain the market share attained with the new efficient Ariane-4 and to launch approximately half of the estimated 200 satellites to be launched by the year 2000. Construction of an Ariane-4 rocket costs approximately DM170 million; in addition to this the client must pay approximately 15 percent of this amount for the launch campaign and for insurance.

Government Funding Problems of FRG's Saenger Project

36980130b Stuttgart *FLUG REVUE* in German
Jan 89 pp 28-29

[Article by Helga L. Hillebrand: "Research Policy: Hypersonic Subsidies"; first paragraph is introduction]

[Text] Only the first phase of the hypersonic technology subsidy plan submitted by BMFT can be financed. After that, work will have to proceed on a European level.

In aviation, airplanes are being envisaged that fly faster than Mach 2. And in space travel, transport systems that take off and land like airplanes could decrease costs considerably. In both areas, there is a need for technologies that the Federal Ministry for Research & Technology (BMFT) will be supporting in a national program that has just been submitted. The guiding concept is Saenger 2, a two-stage, fully reusable space transport system. It consists of a horizontally launching, winged substage topped by a space shuttle.

The BMFT subsidy plan foresees three phases. The first (1988 to 1992) consists of a purely national technology program, for which Bonn will make available up to DM220 million. Added to this is funding from DFVLR [German Research and Experimental Institute for Aeronautics and Astronautics] amounting to around DM86 million, as well as separate capital from industry. The intention here is to concentrate on technology projects for the Saenger substage—essentially a hypersonic airplane—so that the originally estimated cost of DM890 million can be reduced to DM409 million.

This scale of magnitude shows that the two later phases under foreseen by the subsidy plan are only feasible as a joint European project. Phase II will be considerably more expensive by mere virtue of the fact that the construction of a trial rocket is envisaged for it. Under consideration is an airplane for speeds around Mach 5, corresponding to the Saenger substage at a scale of one to four. In phase III, the main emphasis is on the flight demonstration of the trial rocket and on proving the functionality of the complete demonstration engine in flight.

BMFT's overall plan extends for a period of 15 to 17 years. Parallel to this, IABG [Industrieanlagen-Betriebsgesellschaft], together with experts from the universities, is supposed to conduct a comparative system study by no later than 1990. "The task of this study is to help measure the anticipated specific advantages of the

Saenger plan within internationally significant space transport systems," according to the BMFT hypersonic technology subsidy plan. In this sense, the German Saenger option is going up against not only the U.S. space shuttle and Ariane 5/Hermes, but also any future, fully reusable single-stage spacecraft such as the American NASP or the British HOTOL project.

In implementing phase I, BMFT is being supported by IABG, which is functioning as a project backup. The individual jobs have been turned over to so-called master firms, whose project leaders constitute, together with DFVLR, the integrated cooperative team for the project. Within the organizational structure, MBB [Messer-schmitt-Boelkow-Blohm] is responsible for the draft system study, and MTU [Motoren- und Turbinen-Union] for the draft propulsion unit study. The individual technology areas are covered by the following master firms:

- Air-breathing propulsion (MTU)
- Aerothermodynamics (MBB-UF)
- Materials/construction design (Dornier)
- Flight control and systems (MBB-UT)

DM120 Million Lacking for Phase I

Broken down according to specialized areas, there is DM69.7 million for draft studies, DM79.2 million for aerothermodynamics, DM57.4 million for materials/construction design, and DM22.3 million for flight control/systems. By far the greatest share of funding is taken by propulsion, with DM180.3 million. BMFT is supposed to come up with DM344.82 million of this by 1992; however, its resources are inadequate for this. At the moment, BMFT funding amounts to DM20 million for 1988, DM25 million for 1989, DM45 million for 1990, DM60 million for 1991 and DM70 million for 1992, a total of DM220 million. Industry's draft studies on the overall system and on propulsion are supposed to be subsidized 100 percent, while the individual technology projects are slated to receive 80 percent from the ministry. A 20 percent investment by industry is regarded as justified since it is expected that this technology will be applicable to other areas. DFVLR will also contribute resources in the form of investments and personnel.

The potential importance of the hypersonic subsidy program to the German aerospace industry can be seen by looking across the border to France. There, with the Future Supersonic Transport Aircraft (ATSF) and the High-Speed Aircraft, studies are already available for a supersonic and hypersonic project. The Germans will have to present convincing results by the end of phase I if they want to assume the leading role within Europe that they envisage.

Test Facility for Launch Stress Simulation Installed

36980134b Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 12 Jan 89 p 8

[Article: "DFVLR Intends To Test Structural Parts for Spaceflight on the Shake Table in the Future"; first paragraph is FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT introduction]

[Text] Frankfurt—Difficult simulation of actual rocket launch relationships. Schenk delivers MAVIS system to Goettingen.

In contrast to the situation in aircraft construction where aerodynamic loads and their effect on airframes can be determined under actual use conditions in repeatable flight tests, in the aerodynamic structural design of spaceflight systems one is usually forced to rely on ground tests. However, in this process, the limits of the available capabilities are quickly reached, for example, when it is necessary to simulate load reactions like those which occur in the build-up of thrust of the individual rockets which develops quasistatically in the irregular acceleration changes at the beginning and end of the burn or in the pulse-like reactions to the separation of rocket stages.

To be able to perform better work in this area, the Institute for Aeroelastics of the German Research and Experimental Institute for Aeronautics and Astronautics (DFVLR) in Goettingen decided to install a small test facility. The facility, developed in its basic version by the Darmstadt firm Carl Schenk AG and called the Multi-Axis Vibration Simulator (MAVIS), is to form the centerpiece of a structural dynamics laboratory to be built on the grounds of the Institute in Goettingen.

Vibration test systems already exist for seismic investigations; however, at up to 100 Hertz their frequencies are lower than the test range significant for spaceflight, calculated as up to approximately 200 Hertz. Preliminary experiments with earthquake simulators have reportedly shown that it is often difficult to correctly overlay all the high and low frequency acceleration components both in the various degrees of freedom of the total and in their temporal relationship.

As currently equipped, MAVIS consists of a shake table weighing approximately 0.5 metric tons with a 1.5-m x 1.5-m mounting table which can be moved in six degrees of freedom with seven hydraulic cylinders. The usable frequency range in this design reaches approximately 120 Hertz with a payload capacity of 1.0 to 1.5 metric tons. The control unit developed by Schenk even permits adaptation of the system to the dynamic characteristics of the respective specimen, although this can only be done iteratively. In the new structural dynamics laboratory of the Institute for Aeroelastics, an approximately 400-metric-ton seismic slab will be available for the

system to permit extensive dynamic independence of the vibrating system from its surroundings. However, in the future, according to the Institute, a more modern light-weight structure will assume this function.

In the meanwhile, it has developed that interesting applicational possibilities also exist for the multi-axis dynamic structural test concept in aviation technology. Typical specimens, which could thus be subjected to preliminary practical loads even before flight testing would be, for example, helicopter rotors, engine pods, aircraft external loads, and even sensitive avionics components and other equipment.

Obviously, as a rule, even on relatively large test systems, only components and partial structures can be tested, not entire aircraft or complete launcher-payload combinations for spaceflight. As a result, in all the tests described so far, the base accelerations of the specimen must be predefined as interface accelerations in the entire system if the limiting external loads do not directly impact the partial structure to be tested, but are transmitted by way of adjacent structural parts. The capabilities of the simulator could thus be expanded if it were possible to simulate the adjacent structures not present in the test using an electronic simulation network directly within the control loop of the system.

Primary specimens for MAVIS are sensitive partial structures of air- and spacecraft including their electronics and other equipment, whose experimental suitability testing would not be adequate with harmonic or stochastic excitation. For example, the liquid-filled tanks of light-weight construction in satellites and aircraft could be mentioned here. The developers hope that such test systems could also be of interest in mechanical engineering and industrial plant construction as well as in motor vehicle technology.

Cryoelectric Systems for ETW Wind Tunnel Developed

36980131 Coburg MIKROWELLEN & MILITARY ELECTRONICS MAGAZIN in German
Sep 88 pp 578-579

[Article by Dr. Ralph Scurlock, Director of the Institute of Cryogenics, University of Southampton, England: "Cryoelectronics for the European Transonic Wind Tunnel (ETW)"]

[Text] The temperature range in which all electronic modules—including IC's, hybrid systems, instruments, and computer processors—must operate, is largely defined by avionic and military specifications. The lowest temperature is approximately -50 degrees C (223 degrees K).

Until 1984, there was no profitable market demand for electronic systems which operated at even lower temperatures, such as those of liquid nitrogen or liquid helium—despite numerous individual projects which

permitted the development of relatively elementary circuits for specific applications. These would include components with Josephson junctions and SQUIDS (superconducting quantum interference devices) in liquid helium as well as high density computer memories in liquid nitrogen.

One specific development whose success was nothing less than spectacular was the Infrared Astronomy Satellite SIRAS, which made literally hundreds of astronomical discoveries in 1984. IRAS contained infrared detectors cooled in liquid helium and associated non-superconducting signal processing circuits which had been developed at the Jet Propulsion Laboratory in Pasadena (USA).

This situation changed with the appearance of cryogenic wind tunnels, in which aerodynamic models with wing-spans of up to 1 meter are placed in a cold gas stream with temperatures down to -183 degrees C (90 degrees K) and Mach numbers between 0.15 and 1.3. These wind tunnels will require large numbers of electronic systems operating in a temperature range of from -183 degrees C to 27 degrees C (90 degrees K to 300 degrees K). The Reynolds number is a dimensionless number used to characterize the flow of liquids in and around bodies, including the flow of air around an aircraft.

In practice, the air flow of fighter planes and rockets can be simulated in relatively small wind tunnels which operate with the required Reynolds number and suitable Mach numbers. The development of jumbo jets such as the Boeing 747, McDonnell Douglas DC10, Lockheed L1011, and variations of the European Airbus has, however, created a great problem. They fly at approximately 0.85 Mach with a Reynolds number of 20 to 60 million—conditions which lie beyond the capacity of any conventional wind tunnel operating at ambient temperatures.

However, a wind tunnel fulfilling these conditions and operating at ambient temperatures would be out of the question because of the high construction costs and the high operational performance required. The air flow around an aircraft is too complex for accurate calculation or computer simulation, and extrapolation of data from tests with lower Reynolds numbers is unreliable. For the foreseeable future, wind tunnel tests with flight Reynolds numbers and Mach numbers will represent the only way to predict performance data with the accuracy needed to assess commercial feasibility.

A cryogenic wind tunnel in which liquid nitrogen is sprayed into the airstream to reduce the temperature to -183 degrees C (90 degrees K) represents a solution for this. With the decreasing temperature, density increases and viscosity decreases so that for the same model and tunnel dimensions the Reynolds number rises sharply. Because viscosity drops as a consequence of the falling temperature, the fan output required for operation of the wind tunnel is also reduced.

The additional costs for the operation of a cryogenic wind tunnel are therefore determined primarily by the costs of the liquid nitrogen—with the plus factor of the reduced fan output. Add to this another advantage: Because of the variable operational parameters of temperature, pressure, and velocity, aerodynamics specialists using the tunnel will be able, for the first time, to investigate flows under the following comprehensive conditions:

- Reynolds number constant; Mach number and pressure variable.
- Mach number constant; pressure and Reynolds number variable.
- Pressure constant; Reynolds number and Mach number variable.

Currently, there are two major projects, one of which—the cryogenic wind tunnel in NASA's National Transonic Facility at Langley, Virginia—was finished in 1984 and placed in operation.

The second major project is the European Transonic Wind Tunnel (ETW) in Cologne, which should be ready for operation beginning in 1994. The ETW is financed by contributions from five countries [as published]: France and the United Kingdom are each bearing 28 percent of the costs, the FRG 38 percent, and the Netherlands 6 percent. The design phase is virtually complete, and related research and experiments are already proceeding rapidly.

Because the ETW will be expensive to operate and is a multinational installation, different techniques from those used in ambient temperature wind tunnels will be required for instrumental equipping of models. The ETW models will be fully equipped outside the tunnel and will have to be pushed into the working section of the tunnel mounted on portable "carts" with temperatures down to -183 degrees C (90 degrees K).

Following completion of the experimental measurements, the model is withdrawn from the tunnel on its cart and the next fully instrumented model system is rolled in. This process may be repeated at will. Before insertion into the tunnel, the model is cooled to the working temperature in a climate chamber. In this stage, technicians protected by thermal suits will "prep" the model and test the operability of the instruments—all at an ambient temperature of -183 degrees C (90 degrees K).

Wind tunnel models require a large number of sensors to measure pressure and temperature distribution as well as wire strain gages to measure forces and moment over a total of more than 600 data channels on any one model. With ambient temperature operation, many measurements from pressure and temperature sensors and wire strain gages are sent via a wire harness and capillary tubes to primary processing and data logging devices outside the wind tunnel.

This measurement technology cannot be used with cryogenic operation; therefore, an alternative is being tested. For it, a signal conditioning system is located on board the model, with data transmitted out of the cryogenic wind tunnel via a data link to temperature data logging and analysis devices.

The electronic signal conditioning system on the model can either be contained in an isothermic housing, at a temperature of 20 degrees C (293 degrees K) for example to avoid condensation problems, or its temperature can be allowed to drop to -183 degrees C (90 degrees K) with the temperature of the model. Because the total volume available to the model is a cylinder with a diameter of approximately 100 mm and a length of approximately 100 mm, the isothermic housing and its control system occupy most of the available space and leave only limited room for all the sensors and electronic circuitry. A problem could also develop from its heating system, which could affect the surface temperatures of the model and distort the quality of the aerodynamic tests.

The second alternative would be very attractive if the problems could be eliminated.

A systematic investigation of cryoelectronic systems has therefore been initiated by the Institute of Cryogenics in cooperation with the Royal Aircraft Establishment in Farnborough. It is financed by the British Ministry of Trade and Industry. The project's objective is to develop the instruments required for cryogenic operation in the entire temperature range from 27 degrees C to -196 degrees C (300 degrees K to 77 degrees K). It has been found that the problems are not so much electronic as mechanical and involve the differences in the cooling-related contraction of the housing and the silicon chip—a situation which interrupts the electrical contacts.

The objective is to develop electronic signal conditioning systems based on CMOS components, IC's, and Vishay resistors with low temperature coefficients whose output signals are affected as little as possible by temperature changes throughout the range from ambient temperature to the temperature of liquid nitrogen. The next step is the introduction of a temperature-dependent correction of the output signal to obtain the very high level of precision that wind tunnel model data require. An accuracy of measurement of 0.01 percent is sought.

One example of the level of development achieved to date is a single channel precision thermometer unit with a 15-bit A/D converter based on an SMDT (Southampton miniature silicon diode thermometer). This special thermometer was developed in the Institute of Cryogenics and is now marketed on a rather large scale. The SMDT's perform quite accurately in the broad range from -272 degrees C to 202 degrees C (1 degree K to 475 degrees K), are highly sensitive, respond quickly, and are also robust in design.

The cryoelectronic signal conditioning system (ESC) consists of a stable constant source of current, bridging amplifiers, and a 15-bit A/D converter. The 10-microampere constant source of current delivers the forward bias current for the diode thermometer and is based on a serial chopper-stabilized high performance CMOS operational amplifier. The stability of the source of current with repeated thermal cycles between -195 degrees C and 26 degrees C (77.5 degrees K and 300 degrees K) is greater than 0.1 percent.

The buffer amplifier and bridging amplifier are likewise based on CMOS operational amplifiers. With an overall amplification factor of 5, the maximum offset voltage of the amplifier system is less than 150 microvolts between -195 degrees C and 26 degrees C (77.5 degrees K and 300 degrees K) and after the thermal cycle.

The CMOS 15-bit A/D converter with ceramic housing has an output fluctuation of less than 1 LSB between -195 degrees C and 26 degrees C (77.5 degrees K and 300 degrees K) when the input terminals are short-circuited.

The temperature resolution of the thermometer unit is greater than 10 mK, while the absolute accuracy in this stage is limited to 150 mK by the temperature-dependent fluctuation of the entire offset voltage. This absolute accuracy can be improved by 10 mK by correcting for this temperature dependency.

Of course, a great deal remains to be done before a multichannel ESC system which can be integrated into an ETW model is available. However, the advances made thus far indicate that cryogenic ESC systems can be produced practically and are attractive.

Cryoelectronics will also find numerous applications elsewhere, because work with temperatures below -50 degrees C (223 degrees K) in the chemical industry and in the gas and energy sector as well as in medicine will be indispensable with future applications of the new ceramic superconductors.

Accurate measurement at temperatures below -50 degrees C (223 degrees K) always presents a problem because cold sensors are usually connected to warm (ambient temperature) analog instruments via long heavy wires subject to temperature change. The resultant signal deterioration can be prevented by installing cryoelectronic instruments in the immediate vicinity of the cold sensors or building them into the sensors in order to generate amplified digital output signals for recording or optical display. It is expected that the Institute of Cryogenics in cooperation with the Department of Electronics and Computation Science, both of which belong to the University of Southampton, will play a substantial role in the development of cryoelectronic systems for the ETW and other applications.

Military Satellite Project Announced

36980143 Paris *LE MONDE* in French 15 Mar 89 p 48

[Unattributed report: "France Launches Syracuse-2 Space Communications Project for Military Purposes"]

[Text] The General Delegation for Armaments has just awarded the Alcatel company a Fr4 billion contract for the supply of ground equipment for the Syracuse-2 space telecommunications system for military purposes. This system is an improvement on the Syracuse-1 network which has existed since August 1984 and which provides a satellite link between the government and military authorities and the French Armed Forces on land or at sea, from the Antilles to Reunion.

Syracuse-2 will use Telecom-2 satellites due to be put into orbit by Ariane-4 in 1992. This network will have increased capacity, mobility, and protection, and it will be connected to other military communications systems in the world. In addition to satellites in geostationary orbit some 36,000 km from the earth, this system will comprise receiving and transmitting equipment on the ground or on warships for long-distance and high-speed communications, coded to prevent jamming.

This major program uses know-how from numerous enterprises alongside Alcatel, like Matra (which is producing satellites from 1989), and West German, Netherlands, and British companies.

BIOTECHNOLOGY

Dutch Company Formed for Genetic Engineering of Farm Animals

36980150 Rotterdam *NRC HANDELSBLAD* in Dutch 9 Mar 89 pp 1, 2

[Article by Jan Bonjer: "The 'Golden' Calf Costs a Million"]

[Text] Leiden, 9 Mar—By the end of next year, the Netherlands will have its first genetically engineered calves. This is the belief of Leiden professor of biochemistry Dr H.A. de Boer, who recently set up the company Genpharm for biotechnology research on farm animals. The Ministry of Economic Affairs has granted the company a subsidy of 3.4 million guilders.

Stock in the company is controlled by, among others, the American biotechnology company Genencor, Prof De Boer and his wife, Dr S.H. Lee, and the University of Leiden. The university's board of governors is providing all possible assistance to the researcher-entrepreneur, who is maintaining a half-time association with the department of biochemistry.

The startup capital for Genpharm is reportedly 10 million guilders. De Boer refuses to reveal the exact amount. "Just assume that our first transgenic calves will cost a million a piece." Genpharm wants to apply recombinant

DNA techniques to changing the genetic information of cows in such a way that valuable substances are separated out in the milk, such as biomedical proteins or additives for the food industry. Genpharm's first commercial order has come from an American foodstuffs company. For reasons of competition, De Boer refuses to name the company or the substance in question.

Efforts to increase the milk yield of cows through strict selection have been under way for centuries. De Boer now wants to use transgenesis (the application of desirable hereditary factors to the animal's genome) to influence the quality of the milk. There are technological and economic reasons for this. It is expected that transgenic cows will make possible large-scale production of proteins that can be produced by other means (recombinant yeast or bacteria) only with difficulty, if at all. It is also conceivable that the cow will make biosynthesis more economically attractive. In addition, De Boer points out that transgenesis can be used to increase cows' resistance to udder inflammation, for example. But for the time being, Genpharm is not taking on that complex terrain.

Within several weeks, De Boer will be placing Genpharm, a working company, under the protection of an international holding company. To this end, he has entered into a cooperative arrangement with American providers of risk capital. Another working company in San Francisco, which has yet to be established, will also be part of Genpharm International. The American company will be devoted to genetically engineering mice for medical research. Stocks are being developed that suffer from diseases with a hereditary component. This is achieved by added genetic material (DNA) to a just-fertilized egg or by removing existing genes from the mouse. The latter step in particular has been made possible only recently.

Molecular biologist De Boer, together with his wife, an immunologist, started up Genpharm on 1 January of this year. Both came from Genentech, the famous biotechnology company in San Francisco, where Dr R. Strijker too has worked. De Boer is actively gathering together a team of top researchers. The Leiden company will have about 14 employees, whose perks include a stock option plan. Prominent researchers from various countries have joined Genpharm International as advisors. These people include Bob Hammer (University of Texas), who is very experienced in "building" new genetic information into hereditary material.

De Boer, the 42-year-old son of a Frisian farmer, returned to the Netherlands in 1987. After one year, he came to the conclusion that the research into transgenic farm animals that he envisaged is much too costly to be paid for by the university or organizations for scientific research. "It's not possible without money from industry. I have now developed a construct from

which the university can benefit in scientific and financial terms. There will be a major spinoff. If Genpharm earns a profit, the university will also profit from it as a stockholder."

Within the Leiden department of biochemistry, De Boer's entrepreneurial spirit has evoked protest from Dr E.M.J. Jaspars. In the university publication MARE, he writes about a "clear overstepping of the boundary between commerce and the pursuit of university-based science." "In a stealthy manner, thoroughness is exchanged for scientific success." Jaspars' criticism is regarded by De Boer as a flashback to the 1960s. "The time is now ripe for a company like Genpharm. I have no problems with cooperation from the university."

Genpharm's transgenic calves will not be a world premiere. There are already various genetically engineered cows, sheep and goats in Scotland, the United States and Canada. In the Netherlands, efforts thus far have been limited to mice to which hereditary factors were added. De Boer is sticking to the cow, which he calls "my favorite domestic animal. We must not do any crazy things with it." He says that as an "animal lover," he wants to promote the welfare of cows. As an example, De Boer names increasing resistance to disease. "I'm very much in favor of the draft Health and Welfare for Animals Act. There should be criteria that must be met in dealing with and handling animals."

At the same time, the Leiden professor believes that as a researcher he "has the responsibility to increase the efficiency and quality of food production" Biotechnological research offers good opportunities in this sense. "If I knew how to put less cholesterol in a cow's egg cell, I would do it."

De Boer is prepared for criticism from groups such as Animal Protection and Nice Animal: "I'm ready to talk to them anytime."

**CNRS to Open Information-Processing,
Molecular Labs
36980160 Paris AFP SCIENCES in French
19 Jan 89 p 3**

[Text] Paris—The CNRS [National Scientific Research Center] announced 16 January the creation of two new laboratories in Montpellier devoted to information science and industrial information science and to molecular engineering, respectively.

The first is a mixed CNRS/Languedoc University of Sciences and Technologies unit. It will bring together the Montpellier Laboratory of Automation and Microelectronics and the city's CNRS-associated information-science research center. It will conduct research on robotics, industrial information science, computer-assisted design (CAD) and artificial intelligence. With a

budget of Fr17 million, the laboratory will be staffed by 80 researchers, engineers, technicians and administrative personnel, and by 70 doctoral students working on their theses.

The second laboratory will be a CNRS unit called the Laboratory of Molecular Genetics. It will comprise several teams working in the field and will focus its research on molecular genetics and vegetal molecular biology. Financed by the CNRS, the laboratory will have a budget of Fr21 million, will be located on the CNRS campus in Montpellier, able to accommodate up to 150 people.

DEFENSE INDUSTRIES

French 1989 Defense Budget, Programs Discussed

*AN890076 Paris ELECTRONIQUE HEBDO in French
15 Dec 88 pp 12-13*

[Article by Alexandra Schwartzbrod: "Military Equipment: Dual Challenge of Modernization and Research"]

[Text] The military equipment market is vital to the electronics industry. Although 1989 should be a rather good year, there may be a problem in the future: Funding for development is growing at a faster rate than that for more basic research.

"Security is priceless...but it does not come cheap," stated Minister of Defense Jean-Pierre Chevenement a few weeks ago during the submission of his 1989 budget. No other phrase could better summarize the situation that prevails today in the military field. The French Armed Forces are facing a thorny problem: Within the same timeframe, almost the entire range of military equipment—from combat tanks to fighter aircraft, aircraft carriers, and tactical nuclear missiles—must be modernized, while the budget cannot reasonably provide the resources needed to initiate all the programs included in the 1987-1991 military program planning law.

Prioritizing thus seems essential; however, this does not appear to have been done. With the exception of the S4 ground-to-ground ballistic missile, all the programs already begun—both nuclear and conventional—are being continued in 1989, even though this might entail cutting back on some programs or protacting or delaying others.

Two future priorities, however, have been clearly defined: nuclear systems and research. In 1989, nuclear systems will account for 32.2 percent of the military equipment budget (which amounts to Fr 98 billion, i.e., a nominal growth of 7.9 percent or an inflation-adjusted growth of 5.3 percent over 1988). This expenditure covers in particular the new-generation nuclear-powered missile-firing submarine (SNLE). The second characteristic of the 1989 budget is the significant increase in R&D expenditures. R&D funding increases by 14.6 percent in program authorizations and by 6.8 percent in

appropriations compared to 1988. Thus, 30.4 percent of 1989 research expenditures will go to program authorizations and 27.9 percent to appropriations. Within the R&D budget, however, development expenditures have a tendency to grow much more rapidly than basic research expenditures. Development funding increases by 18.4 percent in program authorizations and by 11 percent in appropriations while research funding goes up by only 5.2 percent in program authorizations and even declines by 2.4 percent in appropriations.

R&D expenditures, especially those for development, thus constitute a substantial burden. This is because many major programs today are at the development stage (TN-75 nuclear warhead, the SNLE submarine, the next-generation armored helicopter, third-generation antitank missiles, the tactical fighter aircraft, the nuclear aircraft carrier, etc.). The French Armed Forces are under great pressure to renew their military equipment by the mid-1990s.

Thus, allocation of a larger share of the budget to R&D expenses should be an essential feature of future defense budgets. There is a danger, however. Since development continues to be favored over more basic research, an entire generation of post-2000 military equipment would be placed in jeopardy.

The 1989 budget already shows a certain stability in the level of research funding for nuclear forces. This trend is the temporary consequence of the postponement of the development of the S4 missile and of a reduced effort in basic nuclear research. The only nuclear R&D program that has received a strong increase in funding is that for the construction of the new-generation SNLE submarine. Concerning space, the two key programs—Helios and Syracuse—are at the development stage.

Lastly, in the conventional field, almost all the major programs are at the development stage—ACT [tactical combat aircraft] for the Air Force; combat helicopters, the Leclerc tank, third-generation antitank missiles, and the multiple rocket launchers for the Army; and the ground-to-air antimissile weapon system, the next-generation carrier aircraft, and the Murene torpedo for the Navy.

In his parliamentary report on the status of research in the 1989 defense budget, Jean-Guy Branger, parliamentary representative and member of the Committee on National Defense, stresses that electronic components "must be one of the priorities in our military research effort." He issues a warning to French research: "We must be aware that substantial investment is required in this field. The Japanese, who will certainly become serious competitors in the arms sector, have been able—thanks to tremendous profits reaped from a closed domestic market—to devote substantial amounts to R&D before tackling the U.S. market. In this way they have gained a virtual monopoly in certain components. In recent years, the Americans themselves have devoted

over \$1 billion to the VHSIC military electronic components program. It is an international battle with critical implications. We must realize that if we lack a strategic component and we are obliged to procure it abroad, we might either be turned down, which would compromise the program, or be exacted some "quid pro quo" in the technology field, which would, in the long run, undermine our independence. It is therefore essential that we sustain in this field—where we are strong contenders through Thomson CSF, Matra-Harris, and SAT [Telecommunications Corporation]—a major effort which could find a useful extension within the European framework...."

For now, French Armed Forces policy has three major aspects: strengthening deterrence, expanding the space program, and modernizing conventional forces. Priority in deterrence is given to the ocean-going force. In 1989, funding for the strategic nuclear forces will rise by 8.6 percent in program authorizations (Fr 27,700 million) and by 4.8 percent in appropriations (Fr 24,785 million). The new-generation SNLE submarine is receiving continued support, despite substantial financial slippage. For the remaining period, the program will be allocated more than Fr 25 billion, while its actual cost amounted to Fr 80 billion in 1988.

The program to replace the SNLE's M20 missiles with M4 missiles is proceeding on course. A new version of the M4, designated the M45, is expected in 1994. It will constitute the intermediate stage before the arrival of the M4's successor, the M5, slated for 2002.

The SNLEs are the "cutting edge" of deterrence, according to President Mitterrand. Their modernization is therefore a top priority. The same does not hold for the S4 missile program, which is currently being held up and whose strategic validity is even being questioned. Moreover, its development and preproduction costs are substantial compared to its production costs. The former are said to exceed Fr 20 billion, while the cost per missile, based on a 36-missile run, is under Fr 100 million. Consequently, scaling down the production runs would result in few savings. For all these reasons, the allocations for the S4 program in the 1989 budget have been set at a minimal level—Fr 100 million in program authorizations and Fr 415 million in appropriations.

The 1989 budget provides the funding necessary for the continuation of the prestrategic programs, especially the two major programs, the Hades surface-to-surface missile and the Mirage 2000N. Funding for the Hades program increased substantially both in program authorizations (up 15.9 percent) and appropriations (up 15.2 percent). This increase matches the program timetable, which is currently shifting from the development phase to mass production. The missile is slated to become operational in 1992.

The prestrategic Mirage 2000N fleet, equipped with the ASMP tactical nuclear missile, is further developing with an order for six new aircraft in 1989 (total of orders is 89) and the delivery of 17 aircraft (total of deliveries is 45). According to the program timetable, four squadrons consisting of 60 aircraft are to be operational by 1991. The first squadron of Mirage 2000N aircraft equipped with the ASMP missile came into service in July 1988.

Space program authorizations and appropriations register a significant increase in the 1989 budget that is particularly due to the Helios and Syracuse programs. Under the Helios satellite observation program, carried out in cooperation with Italy and Spain, each country contributes to the development of the system on a pro rated basis based on its entitlement to operational use of the system. Entry into service is slated for 1993, when the first satellite with a 4-year life span will be put into orbit. Syracuse II, the military space telecommunications program, is to replace the Syracuse I, which is slated to be phased out in 1991-1992.

Lastly, there is the modernization of conventional forces, especially with regard to the Air Force, which is faced with the daunting challenge of the tactical combat aircraft (ACT). Appropriations for the Air Force are increasing relatively well, for research (up 11.4 percent) as well as for production (up 13.1 percent). Program authorizations for research are increasing very fast (up 68.3 percent). The reduction in program authorizations for conventional production (down 19 percent) is explained by the lack of new requirements for airborne detection programs and for the Hercules C-130 transport aircraft.

In the research field, the major problem remains the funding of the Rafale tactical combat aircraft or ACT. In all, the Rafale accounts for 43 percent of the program authorizations and 35.9 percent of the appropriations for conventional Air Force R&D. In principle, allocations to the Air Force are made based on its funding 80 percent of the ACT development costs; the Navy is responsible for 20 percent, plus the special costs of the naval version. However, in fiscal 1989, the Air Force also has to compensate for the lack of foreign participation in the program, which brings its share of the state-funded development costs to 85 percent. It also appears that the Navy's contribution (Fr 294 million in appropriations and Fr 418 million in program authorizations) is clearly insufficient given the funding requirements set out in the timetable that schedules actual production of the aircraft for 1996. The Navy is only interested in contributing to the Rafale in order to be able to replace its Super-Etandard aircraft in 2004. At least one thing is certain: The radar will be built jointly by ESD [Electronique Serge Dassault] and Thomson-CSF. However, serious doubts still plague the program, concerning a definite timetable, the consequences of a lack of foreign participation (France's last hope, Belgium, may decide in December), and, lastly, a policy for

the replacement of the aircraft for the Naval Air Forces. (The authorities recently announced an order for a second Rafale prototype for the Navy.)

As regards aircraft manufacturing, the 1989 Air Force budget includes orders for 12 air defense Mirage 2000s and 15 Mirage 2000Ns for tactical ground support to replace the Mirage IIIs of the Tactical Air Force Command [FATAC] in about 1992. The order of six Mirage 2000Ns for the prestrategic nuclear force squadrons brings the total figure to 33 aircraft, i.e., the annual replacement number considered appropriate by the Air Force to maintain its strength of 450 operational combat aircraft. In addition, the Air Force is to order significant quantities of modern weapons (110 Super 530-D air-to-air missiles, 200 Magic II air-to-air missiles, and 100 SATCPs).

The Army is modernizing all of its conventional equipment. In the R&D area, the main programs are the AC3G Franco-German helicopter, the AMX Leclerc tank, and the multiple rocket launcher and its counter-battery radar.

Other systems under development are the helicopter-mounted Orchidee radar with its CL-289 reconnaissance gear, which will substantially enhance battlefield surveillance capabilities. In the production area, one of the highlights of 1989 will be the order for the initial 16 Leclerc tanks to replace the AMX-30s, beginning in 1991. Although the tank's development phase is coming to a close, the program is to undergo a thorough review because of a 26-percent rise in production costs.

Several solutions are contemplated, ranging from a reduction in the number of tanks ordered to a modification of the tank's specifications.

Finally, the Navy also needs to replace its surface fleet. Appropriations for research have risen strongly (up 26.4 percent) while program authorizations show a more modest increase (6.2 percent). This increase is due to the greater firepower requirements of several major programs, in particular the Murene torpedo and the surface-to-air antimissile system.

The Murene is a light torpedo first developed in 1982 to attack the most advanced submarines throughout the next decade. The surface-to-air antimissile weapon system (SAAM) will have to meet the supersonic antiship missile threat in the second half of the 1990s. In particular, the future nuclear aircraft carrier will be equipped with the system.

In the production area, procurement plans call for an eighth nuclear-powered attack submarine, two surveillance frigates, five Atlantic-2 maritime patrol aircraft, 30 Murene torpedoes, and seven SM-39 missiles for nuclear-powered attack or missile launching submarines.

Deliveries will include a tripartite mine hunter and the first Atlantic 2. The dispersal of the Navy's financial effort should lead to a slowdown in the implementation of certain programs, especially the nuclear aircraft carrier program, which is several months behind.

Although the 1989 military budget does not cut across all the major weapons programs, it far from closes the chapter on modernization of the French Defense Ministry. The "best," perhaps the worst, is still to come. "I consider 1989 a year of transition," stated the minister of defense, who committed himself to submit to the next spring session of Parliament a further updating of the 1987-1991 military program planning law.

R&D Expenditures Breakdown Among Nuclear Forces, Space, and Conventional Forces (in Fr million).

	1988 Budget	1989 Budget	Change (in %)
Program authorizations:			
Nuclear forces	11,821.4	11,812.7	- 0.1
Space	2,390	2,793.6	+ 16.9
Conventional forces	15,488.1	19,440.8	+ 25.5
Total	29,699.4	34,074.1	+ 14.6
Appropriations:			
Nuclear forces	11,595	11,549.4	- 0.4
Space	1,085	1,779.6	+ 64
Conventional forces	12,947.5	14,029.9	+ 8.4
Total	25,627.5	27,358.9	+ 6.8

R&D expenditures are up by 14 percent in the 1989 budget.

French DRET's Military R&D Policy Overviewed
AN890077 Paris L'ARMEMENT in French
Dec 88 pp 21-27

[Article by Alain Cremieux, general armament engineer and deputy director of the Department of Research, Studies, and Techniques (DRET) of the Armed Forces Equipment Authority (DGA): "DRET's International Policy"]

[Excerpts] [passage omitted] Not only is it unlikely that 40 years after the second world war journalists will have the opportunity to write laudatory articles on European arms, but the situation will, unfortunately, probably still be the same as today, that is, bilateral and trilateral programs on the one hand and national programs on the other. Of course, Europe will also still be relying on American industry to equip most of its small- and medium-sized armed forces and for the extremely large-scale programs beyond tiny Europe's reach.

There are many reasons for this situation: Technology, the economy, politics, and history together make Europe's arms industry a patchwork whose logic is based on archaic micronationalism. The Department of Research, Studies, and Techniques (DRET) was not meant to assume responsibility for all these areas, but this is a reality that it cannot ignore.

There is no European arms research—only British, West German, or French research. Most other European countries have rather modest research centers (DRET awards contracts in Greece to a team of particularly competent aerodynamic engineers), but there are few if any international centers. The NATO center in Ispra, Italy; the French-German Institute of Saint-Louis [ISL]; and the future European transonic wind tunnel in Postfach, FRG are among the exceptions that confirm the rule.

Not only are there no European research centers, but there are no large-scale European projects on the drawing table.

This situation is not satisfactory. Divided European research has little chance of creating united European programs. The situation is particularly unsatisfactory in that, while European arms are not being created, a civilian Europe is and at an ever-increasing pace. The European Center of Nuclear Research (CERN) exists, ESPRIT 2 is overtaking ESPRIT 1, EUREKA is pooling considerable energies, and the Joint European Submicron Silicon Initiative (JESSI) project is in the process of becoming a true development plan for European microelectronics.

Aware that the status quo in French research is no longer enough, DRET has initiated an expansionist policy, aimed first and foremost toward Europe.

European defense research does not have very well-defined limits. Legally, it includes the members of the Independent European Program Group (GEIP)—NATO minus the United States, Canada, and Iceland. Financially, it is very imbalanced, because research budgets are even more disparate than defense budgets (countries with large defense budgets allocate a greater proportion of these budgets to research!).

That is why the approach is twofold: multilateral, on the one hand, and bilateral with the main countries, on the other.

The bilateral approach has been around the longest. Information exchange agreements between Great Britain and the FRG in the area of defense research date back several decades. The current goal is to instill new life into them by shifting from information exchange to cooperative projects. The memorandum of understanding signed with the FRG in 1986 today enables two research directors to launch projects by signing simple technical agreements; five have already been signed on materials, NBC [nuclear, biological, and chemical warfare], and

lasers. As for the Younger-Giraud agreement signed in December 1987, it is being gradually implemented for research through a series of measures, including:

- technical agreements,
- direct links between the main heads of research,
- joint exploratory developments,
- exchange of engineers,
- participation in technical conferences in the partner country.

[passage omitted] However, that type of bilateral cooperation is not the most original. Cooperation within GEIP is of a more delicate nature but may also be more promising.

The ministers of defense of the European countries of NATO, which include all 12 EC member-states minus Ireland, plus Norway and Turkey, are currently engaged in a vigorous effort to promote the arms industry in Europe. In late 1985, a study was assigned to a committee of 10 "wisemen," including French Ambassador Vernier-Palliez, and chaired by former Dutch Defense Minister Vredeling. The Vredeling Committee produced a report unanimously recognized for its quality and praised for being neither timid nor utopic. The in-depth analysis concludes with the gradual creation of a single European arms market and the possible establishment of a European arms procurement agency. The committee members alluded to it without daring to recommend it. In any case, if one day there were to be a European DGA, historians would be able to trace its origins in the Vredeling report.

The report came out at the end of 1986. It was hoped that GEIP ministers, meeting in Seville in November 1987, would make some decisions along the lines of its recommendations. Andalusian skies were not favorable and decisions were postponed. However, governments did not remain inactive, and results began to materialize at the Luxembourg summit in November 1988 with, in particular, the creation of a permanent secretariat. Its existence, far from preceding the GEIP's essence, will have come more than 10 years later! Another decision taken at the Luxembourg meeting was the establishment of a Research Commission presided over by France.

A European arms industry is therefore beginning to dawn in terms of research. Why? Perhaps because it is slightly less difficult. The development of a European arms industry, in terms of manufacturing, would require tremendous streamlining, and national industries and companies would probably be doomed to disappear. At the development level, though, it is taking shape step by step, with an airplane being developed here, a helicopter there, a missile, a radar device,...but it is not really leading to a European industry. Cooperation in research and technology is justifiably expected to be easier. Still far-off industrial interests may be less sensitive, less obstructive. Scientists are known to be more inclined

toward international cooperation than industrialists. Thus, European arms R&D seems somewhat more likely than simply European arms.

It is in any case desirable. It is difficult to imagine how a European industry could be built on a foundation of totally dispersed and largely redundant research programs. While the number of bilateral or trilateral aeronautics programs have increased these past 30 years, basic research has remained French, British, or German and sometimes Dutch or Italian. The National Office for Aerospace Studies and Research (ONERA) employs few European research workers today (except the French, of course) and, once again, the European transonic wind tunnel and the ISL are exceptions.

The attempt will therefore be toward the development of joint research and technology. This means that governments will gradually finance bilateral, trilateral, and sometimes perhaps multilateral research programs. This will pose all kinds of problems:

- Technical problems: Which projects should be financed? What orientations should be taken? How will it be possible to know if one technique can be more easily Europeanized than another?
- Financial problems: How much should go into a common budget? Should a common budget be established or is joint financing better?
- Legal problems: Which legal context should be referred to and how should the problem of intellectual property be dealt with? Research is being conducted concerning future applications.
- Personnel problems: European arms R&D will not become a reality without exchanges of research workers and even of directors of research organizations.
- Organizational problems: How can the proliferation of an inefficient bureaucracy be avoided?
- Language problems: It is already difficult to hold international meetings, but it is even more difficult to operate the scientific council of a research institute with people of several nationalities. It is difficult not to choose the language of the country where the organization is located.
- Problems of national pride, of course. Who will make the first concessions?

The DRET is in any case involved in a difficult experience within a framework that is European: a Franco-British, Franco-German, or, more recently, a German-British Europe, and, attempting to transcend these fractional Europes, a Europe of 13 countries stretching from Oslo to Lisbon and from London to Ankara which is still trying to find itself.

The preceding must not, however, give the impression that cooperation in research is solely European. A European arms industry is a must, because a united Europe is in the making and defense is an activity that concerns any community that wants to be independent, and arms

are one element of independence. But the world of arms, that is, the Western world, is not limited to Europe. In terms of research, there are two obvious partners.

The first is, of course, the United States, whose defense R&D alone is more than triple that of Europe. Its leadership is unchallenged in many areas, and its desire to cooperate in R&D is sincere. It is sincere at least among those—followers of General Marshall rather than of President Monroe—who realize that the United States needs a full-fledged Europe. A substantial part of the DRET's efforts are therefore focused on the international scene with a view to improving and furthering its relations with the U.S. Administration: the Army, Navy, Air Force, SDIO, and DARPA, its DoD counterpart with which ties are gradually forming.

The second is Japan. West Germany has been called an economic giant and a political dwarf. Japan could be called a civil giant and a military dwarf. But the military dwarf is in the process of growing. Japan's military budget has only recently surpassed the symbolic threshold of 1 percent of GNP and is approaching that of France. Taking into account Japan's preeminence in certain dual-application technologies (civil technologies that are also fundamental for defense), such as electronics, information technology, or materials, Japanese breakthroughs are to be expected in the near future.

This does not mean that within a few months we will be entering into numerous and extensive cooperative ventures with Japan. Geography and politics prevent us from doing so. But it is no longer reasonable to ignore a country growing in military strength as Japan is. The first step will be to get to know and understand each other; those who are familiar with Japan know that this is no easy matter. The second step will be to identify those areas where mutual taboos will not preclude collaboration and, for example, technological exchanges.

We should sell technologies because Japan will buy them and because we have technologies to sell in numerous areas. Furthermore, cases where it would be reasonable to refuse technology transfer are rare, outside the strategic domain, of course.

We should buy technologies because Japan has many and because it is often less costly and more efficient to buy a technology than to reinvent it.

We can only conclude that technologies are crossing borders at an ever increasing rate, and that control of this exchange is the cornerstone of DRET's international policy. Modesty, however, is necessary; let us keep in mind that man did not begin exchanging goods and techniques yesterday. We invented neither the alidade nor the compass, nor the jet engine, nor the transistor and, after all...we did not even invent gunpowder.

FACTORY AUTOMATION, ROBOTICS

New Programming System for Robotic Cells

36980144 Paris AFP SCIENCES in French
19 Jan 89 p 23

[Text] Valenciennes—The Industrial and Software Engineering Laboratory of the University of Valenciennes has just developed a new off-line programming system for robotic cells capable of operating a flexible production shop or coordinating the cooperation of several robots on a single task. The system, which uses the universal language ADA, used notably by the United States Defense Department, can be used on all types of computers which have ADA language.

Its "inventors" are going to design the system to allow future automatic modification of programming according to the identity card of each robot. They also intend to design new programs in more highly evolved language somewhat closer to that of human language. The system was designed under the direction of Professor Soenen, president of the inter-university automated-production shops, and by Yves Sallez, an automation specialist.

This new system is a follow-up to the European ESPRIT No 623 project, which brought together the companies Renault-Automation and KUKA, a West-German robot manufacturer, Karlsruhe and Valenciennes Universities, ENSAM [National School for Automation and Manufacturing?] of Paris, and Institut IPK [Institute for Planning and Cybernetics] Fraunhofer of Berlin.

The programming system is currently a prototype that operates on a VAX 8300 or micro-VAX computer, but it can be installed on all types of computers which have ADA language. The Valenciennes Laboratory of Industrial and Software Engineering asks all interested laboratories or manufacturers to contact it.

ESPRIT Project on Communication Systems in CIM Environment

36980156 Milan AUTOMAZIONE E STRUMENTAZIONE in Italian Oct 88 pp 159-165

[Article by Dr Engr Carlo Borasio, Dr Angela Maria D'Angelo, Dr Elisabetta Ferrero, all of ELSAG [Elettronica San Giorgio], and Professor Engr, with degree in Mechanical Engineering, Roberto Groppetti, of Politecnico di Milano]: "Communication Systems in CIM Environment: ESPRIT Project No. 1217 (812)"

[Text] **Abstract**—This paper describes the architecture and communication strategy adopted for the CIM [Computer-Integrated Manufacturing] Experimental Center which is now in the installation and implementation phase at Genoa under ESPRIT Project 1217 (812). The CIM Center is subdivided into two main application areas—the Technical Area and the Shop Floor Area—with three communication levels based on three types of networks.

The paper analyzes the conceptual control and communications architecture that is to be implemented when the standards relative thereto have been conclusively defined and made available and the components characterized and adopted, and the architecture as currently being implemented, involving the use of "ad interim" solutions in those cases where the definitive standards are not yet available.

1. Introduction

Project 1217 (812), titled "Experimental Center for System Integration in CIM," which is being partially financed by the EC [European Community] Commission under the ESPRIT European Research Program, is being developed by a consortium of firms under the prime contractorship of ELSAG. The consortium partners are: ELSAG (Italy), Aeritalia (Italy), Philips Mble (Belgium), Politecnico di Milano (Italy), SESA (France), and WZL-RWTH Aachen (Germany). ELSAG's subcontractors are: DEA (Italy), ITALCAD (Italy), IMU CNR (Italy). This article is based on the results of the work being done by the partners under the project.

The object of the project "Experimental Center for System Integration in CIM" is to develop an experimental and demonstrational CIM environment that is representative of a broad class of typologies in the flexible workshop production sector, and that is open to the progressive integration of different subsystems, manufacturing functions, and technological processes.

The purpose of the Center is to take advantage of data management, processing and communication methods for the purpose of developing and evaluating advanced components, type architectures, data bases, and communication subsystems for integration of software, all in connection with CIM technology. By proceeding on the basis of an open configuration and borrowing from the results of other ESPRIT projects involving architectures open to CIM integration, and by adopting a suitable hierachic control and communication system, the Center has been provided with the characteristics necessary for extending its scope to meet the needs of potential users. From this standpoint, the Center's communication architecture and relative communication and "migration" strategies can be viewed as the fundamental requisites in its design [1-4].

The planned integration of cell and operating-unit hardware and software to be provided by different suppliers requires that the Experimental Center use a standard communication system. It was decided, therefore, to use the communication protocols defined by the MAP [Manufacturing Automation Protocol] [5], by the ESPRIT CNMA [Communications Network for Manufacturing Applications] [6], and in particular, to use the MMS [Manufacturing Message Specification] RS-511 protocol as a common language for communications among the different operating units [7, 8]. The plan for developing

communications within the system calls for implementation of a project conforming to these standards, commencing with the realization of a transparent structure at the "application level," using "ad interim" solutions in cases where those standards are not yet available.

The system now in the process of realization is analyzed in the following sections of this article, with particular reference to its architecture, its communication strategy, its "migration" strategy, and the solutions adopted [7-9].

2. Communication Subsystem

The architecture of the communication subsystem in a CIM environment can be structured according to a multilevel hierachic approach, with three basic levels corresponding to three types of network:

- The factory network, which links the computers to the workstations at which the design, design support, and production planning and management activities take place;
- The workshop or "Shop Floor" network, which links the Cell Controllers, the transport subsystem, and the workshop computers, and over which the control of production and of common workshop services takes place;
- The cell networks, which link the operating units to their respective Cell Controllers.

To these three basic levels of communication is added the lower level of the units and devices that interact with the process (sensors, actuators).

Each of the three networks carries communications characterized by different requirements in terms of type of data, traffic, response times, etc.

The cell network carries the required ongoing exchange of information between the Cell Controllers and operating units, for the monitoring and control of the process: Small and frequent quantities of data are processed in real time.

The workshop network supports the communications between computers and between terminals and computers. Typically, the computers are dedicated to specific area-control and plant-control functions. Here, the exchange of data between nodes consists of longer but less frequent messages than in the cell networks.

The factory network can handle local or long-distance communications, depending on the size of the enterprise. Generally speaking, communications at this level consist of exchanges of high volumes of data among diverse functions relating to different technical, engineering and workshop disciplines, and involving different technologies, with less emphasis on speed of communications than in the case of the workshop network. Factory functions may require links with the WAN's

[Wide Area Networks] that provide communications, for example, between plants located geographically distant from each other and/or between factory and suppliers.

The required specifications for each area, or level, can be met by different standard networks: A cell network can be designed using private networks provided by the supplier of the computerization, or using standard networks of the broadband IEEE 802.4 or baseband types, such as those currently being defined by the MAP group. The factory and workshop networks can be designed using a network of the IEEE 802.3 CSMA/CD or baseband or IEEE 802.4 broadband type.

3. Architecture

The layout of the ESPRIT Experimental Center (Figure 1) is structured in the form of functional areas, in which the operating units are grouped according to the type of operations they must perform on the work in process. Each area is made functionally autonomous by means of a locally controlled work-transfer system, while the physical integration at the workshop level is done by an AGV transport system through local interface stations. The Center is subdivided into the following areas:

- Tool presetting, or Tool Room, area;
- Warehousing Area;
- Setup Area;
- Cell for the machining of prismatic parts, or Prismatic Cell;
- Lathe, or Turning, Cell;
- Assembly Cell;
- Vision, or Inspection, Station.

The Center's functional model was divided into two application areas (Figure 2) [1-4]:

- The Technical Area which groups the product design, process design, and production planning and management functions. This area includes the CAD [Computer-Aided Design] workstation, the CAM [Computer-Aided Manufacturing] workstation, the MRP [Manufacturing Resources Planning] computer, the Scheduling workstation, and the Data Base Server. For this network, as will be discussed in more detail herein, the IEEE 802.3 CSMA/CD standard has been adopted.
- The Shop Floor Area which groups the activities that control the manufacturing process. This area includes the Shop Floor computer, the Cell Controllers for the Assembly Cell, Inspection Cell, Turning Cell, Prismatic Cell, Setup Area, the Warehousing Area, and the Tool Room area [3, 4]. For this network, as will be discussed in detail herein, the IEEE 802.4 broadband standard was adopted.

In the paragraphs that follow, we describe and analyze the conceptual architecture, or implementation model, that is to be achieved eventually, and the "as-is" architecture, or implementation model, that has been adopted

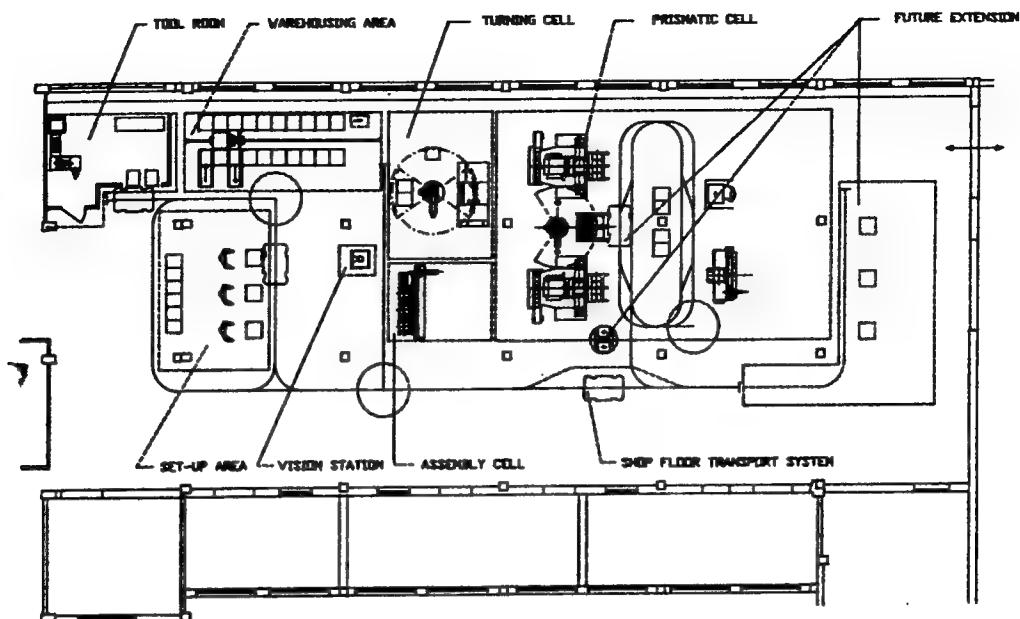


Figure 1. ESPRIT Experimental Center Layout.

as a transitional solution to enable realization of the Center to proceed, considering the constraints stemming from unavailability of suitable components on the market and of complete and definitive "de facto" or "de jure" communication standards.

3.1. Conceptual Architecture

To render the conceptual architecture truly representative of the potential real situations, the Technical Area and the Shop Floor Area were differentiated from the standpoint of their communications networks: Two different ISO standard network types were adopted and interconnected by a bridge.

3.1.1. Technical Area

In the proposed architecture for the Technical Area, the computers and workstations are integrated by means of a TOP/CNMA network. The operations performed in this Area are integrated by means of a Data Base Server, where the data to be exchanged are memorized and retrieved. Since these activities do not exchange data directly with one another, but rather by means of the Data Base Server, the degree of "coupling" among them may be defined as "loose." Since the ESPRIT Center is being implemented on the basis of existing subsystems that use their own data bases, a "tight coupling" among

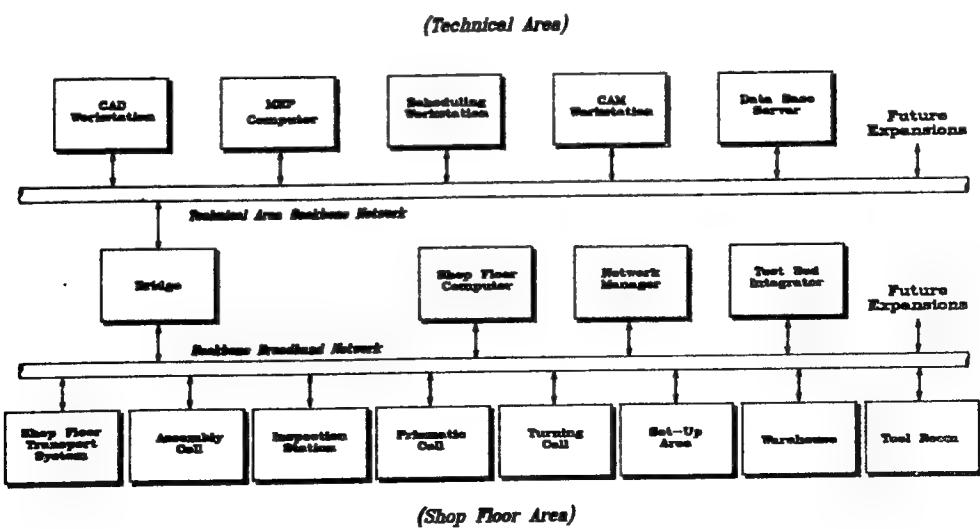


Figure 2. The Two Application Areas of the Center's Functional Model.

all the functions of this Area is neither required nor realistic. The organization and strategy of the Technical Area's data are therefore characterized by:

- A diversity of local data bases;
- A grouping of functions around their respective local data base, and tight coupling to it, constituting different subsystems;
- Integration of the subsystems by means of the data exchanges effected through the Data Base Server.

Thus, the different applications have only to memorize and retrieve the needed data from the Data Base, using standard SQL [Structured Query Language] commands. Further activities can be added subsequently, either as new software functions being implemented on existing computers, or as functions being developed on new computers, which—in order to be integrated into the network—must be provided with a suitable communications interface and must moreover support the software interface of the Data Base used.

3.1.2. Shop Floor Area

The Shop Floor Area encompasses the functions for real-time control of the manufacturing process. These functions are integrated by the exchange of commands and feedbacks between the software modules that configure the process-control subsystem, in accordance with a hierarchical architecture, in which the monitor functions are performed at the lowest level possible. Each control level has a local display of the functions being monitored and masks its internal operation at the higher levels.

In ascending order, beginning at the lowest level, the following subdivision is defined:

- At the Unit or Numeric Control level, all the activities and operations the machines being controlled must effect to execute the parts programs and to process the part to be machined (for example, axis maneuvers, tool changes, positionings of the part within the machine, etc) are displayed in full;
- At the Cell level, all the activities necessary for the routing of parts among the various operating units comprising the Cell are displayed, without a direct display of the micro-operations executed by each unit being controlled;
- At the Shop Floor level, only the operations necessary to execute the work orders assigned to the different cells and for the routing of the parts among cells are displayed.

This hierarchical control structure is matched by a hierarchical communications architecture structured as follows:

- Direct communications between Operating Unit Controllers with regard to the exchange of synchronization and accident-avoidance signals (for example,

signals between the CNC [Computer Numerical Control] system and transport subsystem to synchronize a pallet change, etc). For this type of interface—for which a standard is not available—the data are exchanged via parallel I/O [Input/Output];

- Communications between the Cell Controller and the controlled devices (CNC, transport subsystem controller, etc) relative, for example, to the transfer of parts programs, the start of execution of parts programs, transport mission control, etc. These communications take place by means of a network operating in real time with standard protocols such as MMS and MAP/EPA, or by means of private networks;
- Communications between the Shop Floor Controller and Cell Controllers, for the exchange of production orders and information relative to the stepping up of production, for the transmission of parts programs and machining cycles, etc. These communications are carried by a standard multivendor network using the MMS [Manufacturing Monitoring System] protocol. This protocol will probably have to be extended to include the services necessary to integrate different types of cells or areas.

In the proposed architecture for the Shop Floor area, the computers are integrated by means of a broadband MAP/CNMA network with the standard protocols designed for applications in a factory automation environment.

3.2. The As-Is Architecture

Since all the products conforming to the standards adopted for the Center do not exist at the present moment, some temporary solutions have had to be adopted, together with a strategy, however, that takes into due consideration the ultimate objectives the Center has set out to attain.

3.2.1. Technical Area

The architecture presently being implemented in the Technical Area is illustrated by the hardware configuration shown in Figure 3. To emphasize the concepts of integration of different functions performed by different computers in diverse environments, the Area is shown made up of various workstations or computers interconnected by a common network. Each workstation is dedicated to a particular function and is made up of a different combination of hardware and operating system. The communications network interconnecting the workstations with the Data Base Server integrates all the functions being implemented. This network, which connects the pertinent computers to the Technical Area, is an Ethernet network conforming to the CNMA project TOP and Implementation Guide [6]. Given the present unavailability of products compatible with TOP/CNMA network specifications, the Decnet and TCP/IP protocols were adopted and will coexist in the same network.

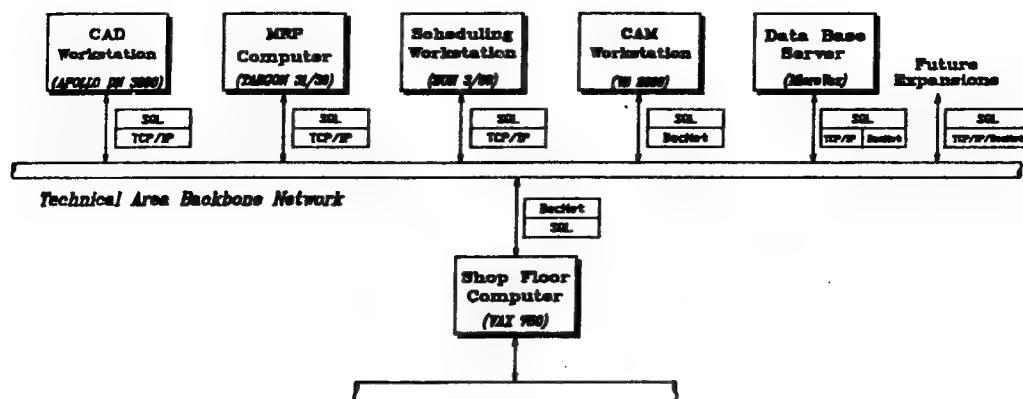


Figure 3. Technical Area Hardware Configuration.

The following hardware configuration was adopted:

- CAD workstation: Apollo DN 3000 with Apollo Domain operating system;
- Computer for MRP: Nixdorf Targon 31/30 with UNIX operating system;
- Scheduling workstation: Sun 3/60 with UNIX operating system;
- CAM workstation: VaxStation 2000 with VMS operating system;
- Data Base Server: Micro-Vax with VMVS operating system.

Since a real bridge between the two communication networks could not be realized using presently available products, the ad interim solution adopted for interconnecting the Technical Area with the Shop Floor Area was

to connect the Shop Floor computer directly to the Ethernet network. Communication between the two areas is thus concentrated in functions provided by the Shop Floor computer.

3.2.2. Shop Floor Area

The architecture being implemented in the Shop Floor Area is illustrated by the hardware configuration shown in Figure 4. The hardware architecture is configured in accordance with the same subdivision into functional areas as characterizes the physical layout of the Center.

Integration of the different areas is provided by a broadband network that links the various Local Controllers. Since communications exert a major impact on software

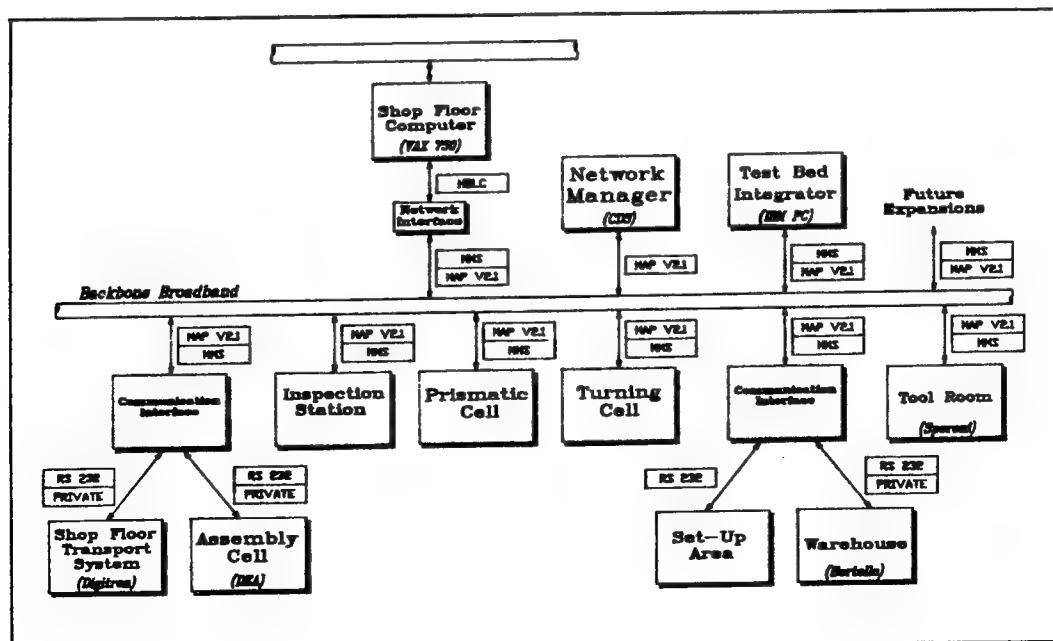


Figure 4. Shop Floor Area Hardware Configuration.

development in this type of architecture, a suitable strategy was adopted to minimize this impact and simplify the evolution or "migration" towards standard solutions, based on the following criteria:

- For communications at the Shop Floor level, the MMS protocol was adopted at the application layer (Layer 7 of the ISO/OSI model), extending the services to include those necessary for management and coordination of the materials flow among cells;
- Equipment and devices can be directly connected to the network used, provided they are equipped with suitably compatible hardware and software interfaces, and provided their functional capabilities are compatible with the functional model of the Center;
- Deviations from this standard will be resolved locally using a communications interface to provide a conversion of protocol and functional integration in accordance with the model.

By following these criteria, software development at the Shop Floor level will be influenced by the characteristics of the integrated operating units or cells.

The Shop Floor network is a broadband token-passing network compatible with the MAP 2.1 version, but this is an ad interim solution, in that it will be replaced by the MAP 3.0 network when products meeting these specifications become available. The Shop Floor computer is a VAX 11-750, on which development of the MAP communications software is based, and which interfaces directly with the MAP network.

The various cells and functional areas are configured in different ways depending on their internal architecture. Cells based on Elsa hardware are connected directly to the network and perform direct-control and communications functions compatible with the functional model of the Center. Cells supplied by other vendors are connected to the network by means of a communication interface made up of Elsa hardware. This interface performs a protocol conversion; that is, it translates the network protocol into the private protocol used by these Cell Controllers, and develops the functions necessary to conform these cells to the general functional model of the installation: Normally, this hardware is shared by several Cells.

The Shop Floor transport subsystem has an asynchronous private protocol that must be emulated by the communication interface. This interface also supplies the functions required to enable various users to share the transport subsystem.

The Assembly Cell has its own controller with a communication protocol that must be emulated.

The communication interface interprets the work orders and presents a homogeneous interface to the Shop Floor Computer.

The Setup Area is devoted to manually-controlled operations. The operators interact with the system by means of terminals connected to the communication interface that provides the Cell Controller functions for this area.

The Warehouse has a private protocol of its own, which must be emulated by the communication interface. In this case as well, the interface supplies the functions that are not made available by the Warehouse Controller, which provides only the monitor functions needed for controlling the warehousing and drawing of parts.

The Cell for the machining of prismatic parts is managed by an Elsa 5000 Cell Controller (Figure 5), and encompasses the following operating units:

- Two machining centers each controlled by an Elsa 1000 Numerical Control;
- A robot controlled by a Siemens Numerical Control, for the maneuvering of the tools;
- A Washing Station directly controlled by the PLC functions included in the Elsa 5000 LCU [Local Control Unit];
- A DEA Measuring Robot controlled by its own standard controller linked to the Elsa 5000 LCU, where the protocol conversion takes place;
- Operator Buffers and Terminals under the control of the Elsa 5000 LCU.

The Elsa 5000 Cell Controller is directly connected to the MAP network. The Cell hardware architecture conforms to the hierarchic architecture of the entire installation; hence, the Cell's internal architecture does not influence the development of software at the Shop Floor level. The Cell Controller interfaces directly with the Shop Floor network and interacts with the Shop Floor computer and the other cells by means of the MMS protocol. Communications between the Cell Controller and the Cell operating units are carried by the ElsaNet private network, still using the MMS protocol. Within the Cell, as well as at the Shop Floor level, when an operating unit does not support standard MMS communication, the unit is connected to the network by means of an adaptor. The LCU enables connection with the Measuring Robot (which uses a private protocol) and manages the automation functions of the Washing Station and of the buffers not equipped with local electronics. Since the management of tools during the execution of a parts program competes with numeric control, the tool-maneuvering robot is connected directly with the numerically-controlled machine tools, with which it exchanges synchronization and accident-prevention signals via parallel I/O.

The Lathe, or Turning, Cell is controlled by an Elsa 5000 Cell Controller connected directly to the MAP network (Figure 6).

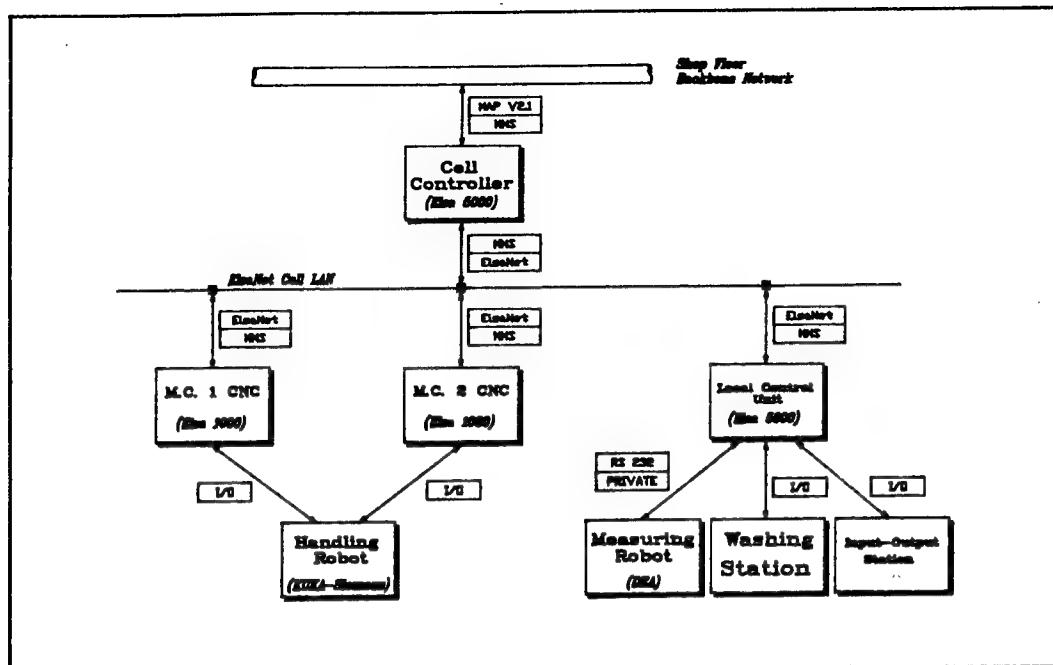


Figure 5. Elsa 5000 Cell Controller for Machining Cells.

The Cell operating units are:

- A lathe controlled by an Elsa 1000 Numerical Control;
- A robot controlled by a Siemens Numerical Control, for maneuvering of parts and tools;
- An operating unit, simulated for the time being, for measuring diameters, controlled by the Elsa 5000 Cell Controller.

The Handling Robot's parts maneuvering function is controlled by the Cell Controller and communicates directly with it. Since the Robot Controller does not have a communication capability beyond the I/O signals, the missions to be accomplished are communicated in the form of program parameters by means of parallel signals.

The Input/Output Stations and the diameter-measuring machine are controlled directly by means of I/O signals.

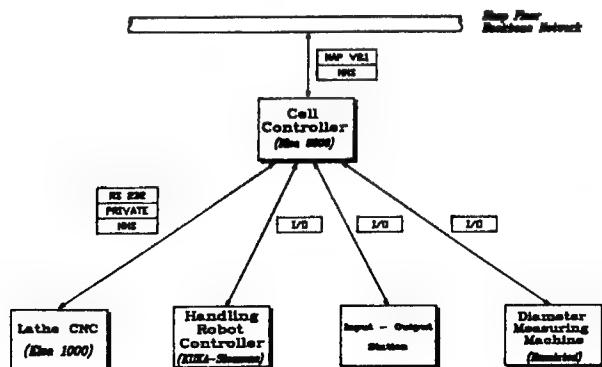
To add to the Center's openness, plans call for connecting a TBI [Testbed Integrator] to the Shop Floor network. This TBI can be considered a module or an instrument for the integration of new devices. Planning calls for this module to enable testing of new devices at the application level, prior to their definitive integration. The tasks planned for the TBI include:

- Verification of the suitability of the messages exchanged by the new device from the standpoint of the communication protocol;
- Emulation of the operation of a device, such as a CNC or a robot controller, with respect to functional communication capabilities;
- Simulation of the Cell Controller in communication with the Shop Floor computer;
- Monitoring and handling of messages between devices being tested while integrated into the network. This function can be likened to that of a conformance tester for verifying suitability and compatibility with the communication standard.

4. Conclusions

To provide for the evolution or "migration" of the adopted communications architecture towards the chosen conceptual one, it became necessary to design the system altogether independently of the adopted networks, designating and isolating those parts that can be replaced with new implementations.

Figure 6. Elsa 5000 Cell Controller for Lathe Cell.



The adopted "migration" strategy for attaining the definitive standard in the Technical Area calls for the following progressive steps:

- A standard protocol for the Technical Office Network must be defined and made available;
- This standard must be supported by suppliers of Data Base Distributed Systems or Network Data Base Systems;
- Since the integration software written to enable access to the Data Base Server interacts only with the network services through earlier SQL standards, the type of network, the relative protocol, and the network services of the data base software can all be changed without in any way affecting the applications.

Similarly, for the Shop Floor Area, the adopted strategy calls for the following steps:

- When the definitive CNMA/MAP 3.0 specifications and the relative network components become available, the MAP 2.1 version can be updated by updating the firmware on the Network Interface Board, without any impact on the application software;
- When the final MMS specifications are released by CNMA, the present MMS implementation will be updated. This will have a modest impact on the software that has been developed, from the standpoint of the complexity of the changes in standard. Moreover, isolating the present communication software interfaces as separate and distinct modules will make the incorporating of future updates into the as-is MMS implementation much easier and less costly.

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LASERS, SENSORS, OPTICS

Italian Consortium for Remote Sensing R&D

36980159c Rome NOTIZIE AIRI in Italian
Nov-Dec 88 pp 21-22

[Article: "CO.RI.STA Created"]

[Text] An agreement was signed in a ceremony held on 16 November in Naples, at the Rectory of the Universita degli Studi [University of Research], creating the CO.RI.STA [Consortium for Research and Development of Advanced Sensors].

This research Consortium's primary objective is the development of innovative technologies and equipment in the earth observation sector, and the testing of such instruments using an airplane as an experimental airborne laboratory, together with the necessary ground-based structures, with a view to their future use aboard satellites.

The systems to be developed will have observation capability at night and in the presence of clouds, and will be based mainly on synthetic-aperture radar and high-definition optoelectronic systems. Such systems will add a new and important contribution to monitoring of the environment and of Earth's natural resources, and will be used in an essential civil-defense support role, a particularly acute problem not only in Italy but also throughout the Mediterranean Basin.

The Consortium will carry out its scientific, productive and training activities in the Mezzogiorno, and looms as an important constituent of the existing Italian and international space activity.

The CORISTA Consortium is made up of major industries that operate in the electronics and space sectors and that have numerous productive installations in Southern Italy (LABEN, Officina Galileo, Selenia Industrie, Selenia Spazio, and Tecnopolis-CSATA), as well as the Universities of Bari and Naples, which have long been active in the remote sensing sector.

Professor Sergio Vetrella, docent of Aerospace Systems, Faculty of Engineering, University of Naples, has been named president of the Consortium.

MICROELECTRONICS

Thomson, Aerospatiale Establish Flight Electronics Group

36980119a Paris *L'USINE NOUVELLE* in French
8 Dec 88 p 26

[Article by Jean-Pierre Casamayou "Thomson-Aerospatiale: A Marriage of Convenience"]

[Text] By consolidating their airborne-electronics business, Thomson and Aerospatiale are sending out the signal of an inevitable restructuring of French aeronautical firms. Although the actual terms and conditions remain to be defined, the consolidation will place this industrial center in first place in Europe.

The aeronautical equipment industry is counterattacking in face of the large foreign maneuvers. After the consolidations accomplished or in the planning stage in England and in Germany—British Aerospace-Rover, Daimler Benz-MBB and Siemens-GEC-Plessey—the surprise announcement of the merger of the Thomson-CSF and Aerospatiale avionic business marks the beginning of the thrust. A counteroffensive initiated by a concentration of French troops, yet without neglecting the search for foreign partners. Thomson is advancing in its cooperation project with British Aerospace in matters of defense electronics. To compete with the world leaders, the French have chosen to unite on the basis of trades, an approach opposite to that of their competitors who prefer vertical concentrations, such as Daimler-Benz marrying automobiles, planes and jet engines with electronics.

The first firms involved are three affiliates of Aerospatiale (Crouzet, Sfena, and EAS) and the general avionics division of the Thomson-CSF aeronautical equipment branch. They are giving themselves three months to form the first European center of aviation electronics: an entity of 8,000 people having revenues of Fr3.7 billion which places it in fourth place worldwide, behind Honeywell (9 billion), Litton (5.1 billion) and Allied Signal (4.8 billion), but in front of Smiths Industries, the first European firm.

Although conversations are continuing between Alain Gomez and Henri Martre, the government authorities have already defined the provisions of this consolidation. It will be accomplished within a holding company shared equally by Aerospatiale and Thomson, to be followed by offerings to other shareholders. This plan also shows the concern for creating an aeronautical equipment company truly independent of an aircraft manufacturer. As a matter of fact, one cannot aspire to sell major systems to another manufacturer if one is a subsidiary of his competitor.

Another advantage of such a center is to provide the industrial and financial means for developing—at long last—integrated flight control systems which replace the multiple independent devices and indicators of the old cockpits. It is thus that a single management would be able to federate and rationalize the specialties of the four firms.

But such a marriage will not be easy. It will be necessary to resolve the problems of responsibility for industrial sharing and redundancies which will not fail to crop up. If, insofar as the actors are concerned, it is still too early to express an opinion on this restructuring, the government has decided to support the employment. The consolidation would thus be made around the Crouzet group which would not be dismembered. The "components" and "terminals and systems" businesses (70 percent of the group presided by Roger Champt) will remain within this new company. And in high places, emphasis is being directed to the necessity of retaining most of the plants, particularly in the provinces. It seems, therefore, that the first movements will at once affect the design offices and the Paris area.

This official consolidation announcement carries the risk of accelerating the cooperative process of aeronautical equipment manufacturers. A second one involving radars between Electronique Serge Dassault and Thomson is virtually finished. There still remain sectors like gyrolasers—between Sfena and Sagem—or optronics. A field split among six companies, but Thomson has already taken a long lead here by consolidating its forces within a unit already strong with 800 people in it.

The Contemplated Consolidation.

Firms	Aerospatiale			Thomson
	50%	HOLDING COMPANY: Aeronautical Equipment		50%
Revenues	Fr2,240 million	Fr1,340 million	Fr167 million	Fr1,570 million
Employees	3,600	2,280	240	1,880
Products	Flight Instruments	Navigation, Flying	Radio, Communications	Visionics
Plants	Valence	Velizy	Le Bourget	Issy-les-Moulineaux
	St-Agreve	Chateaudun		Le Haillan
	Crest			Vendome
	Ales			Toulouse

After the consolidation, Thomson and Aerospatiale will call upon the stock market.

French Firm Develops Optical-Chip Sensor
36980119b Paris *L'USINE NOUVELLE*
(*TECHNOLOGIES supplement*) in French
8 Dec 88 p 51

[Article by Marc Chabreuil "The First Optical-Chip Sensor"]

[Text] An industrial first for CSO; all passive optical components of an interferometer are integrated into a 49-mm² silicon chip.

After microelectronics, silicon finds an unanticipated application: optics. The Optical Sensor Company (CSO), a Grenoble PMI of five people, has in fact succeeded in integrating all of the passive optical components of an interferometer (lenses, mirrors, semitransparent plates... onto a 49-mm² chip, 500 microns thick. An industrial "first" which, during the coming weeks, will enable it to market a 2-cm³ micro-displacement sensor rather than the usual several cubic decimeters. Furthermore, it will be ten times less expensive than conventional optical elements. The sensor itself will be sold in the neighborhood of Fr5,000 to which should be added the same amount for the driving electronics and, eventually, between Fr2,000 and Fr5,000 for the signal processing systems.

Developed in the Leti guided optical laboratory for seven years, the technology of integrated optics calls upon practically the same manufacturing procedures as integrated circuits (deposits and etching of thin layers). This similitude explains the utilization of silicon which, in this case, is used solely as a mechanical substrate. In addition, it presents interesting cleavage qualities (cut through a crystalline plane). Thus, the input and output faces are optically perfect, even without polishing. This property permits direct coupling of the luminous source, an infrared laser diode having a power of less than 0.5mW.

The assembly consisting of the sensor, laser diode, Peltier-effect module, driving photodetectors, amplifier, and counting system of the interference and micro-optical collimation fringes of the luminous beam (200 microns in diameter) is contained in a cylinder 30 mm long and 20 mm in diameter.

This sensor utilizes the Michelson interferometer principle: the luminous beam emitted by the laser diode is reflected by an object and is then separated into two parts each of which follows a different path before being superimposed to create interference fringes whose spacing is measured. Usable at a distance between 0 and 100 mm with a resolution of 0.1 micron, it is intended first of all for manufacturers of dimensional measuring instruments (displacements, mechanical dimensions, vibrations, deformation, roughness...). Its possibilities open other markets: measurements of indices, gaseous density or dilution, robotics, automation.

Cooperation of French Firms on JESSI Projects
Recommended
36980119c Paris *L'USINE NOUVELLE* in French
24 Nov 88 pp 60- 61

[Article by Dominique Commiot and Alain Dieul "Microelectronics—Inevitable Cooperation of Research Laboratories"]

[Text] Only an integrated research program associating the Cnet and LETI laboratories will permit optimizing the incredible investments required by the development of the new generation of integrated circuits. The idea is making its way under the provisions of the JESSI program which is mobilizing European microelectronic forces.

Is it really reasonable that the two principal French microelectronic research laboratories continue to develop in parallel, and at times in competition, their work on the next generations of integrated circuits?

The Norbert Segard Center of CNET [Telecommunications Studies Center], 400 persons, including 300 researchers and an operating budget of Fr230 million, and the Data Processing Electronics and Technology Laboratory (LETI) of the CEA [Council of Economic Advisers], with 900 employees, including 400 researchers and a budget of Fr650 million, are located several kilometers from each other at Grenoble. Would it not be to their advantage to consolidate their means and share the research problems?

The question is raised with a particular acuteness since the launching of the European JESSI program [Joint European Submicron Silicon Initiative]. The big three of European microelectronics (Philips, Siemens and SGS-Thomson) have finally agreed to enter into a mutual program of research on submicronic integrated circuits. About Fr3 billion per year are to be committed, during a minimum of seven years, half of which will be assumed by private industry, and the remainder by the EC and the countries involved.

Europe thus hopes to reduce its technological dependence which is becoming very dangerous. Semiconductors are manufactured in Japan (50 percent of world production, and even 85 percent for memory circuits) or in the United States (about 40 percent) as opposed to barely 10 percent in Europe.

All European microelectronic laboratories are involved in JESSI, the counteroffensive of the last chance. Particularly, LETI and the Norbert Segard Center. Since four years, LETI has been developing prototype circuits and new MOS processes ordered by the electronics branch of Thomson-CSF and, hence, for SGS-Thomson since the merger.

Thus, the 1-micron CMOS process developed by LETI is utilized on the most advanced lines of an SGS-Thomson factory at Rousset. Within the provisions of JESSI, the

Franco-Italian group is in charge of designing the future reprogrammable memory circuits (Eeprom). As for the Norbert Segard Center of Cnet, its reputation in the design of integrated circuits specialized in telecommunications no longer needs to be proven. It has several processes available, including a 1-micron CMOS which was the subject of a technology transfer for the benefit of Matra-Harris Semiconductors (MHS) to produce 64K SRAMs.

For the next phase, however, it is a matter of being able to etch 0.5-micron circuits. In this case, all of the present equipment (clean rooms, machines...) are outmoded. And the technical constraints of the future buildings (cleanliness, quasi-absolute insensitivity to vibrations...) are going to involve colossal investments, not only at the industrialization level, but even at the laboratories. "In two or three years," explains Jean-Pierre Poitevin, the CNET manager, "our present equipment will be obsolete. The pilot line required to produce 0.5-micron etched chips represents an investment of about Fr500 million, or ten times more than the cost of the present 1-micron lines!" LETI has already planned to construct a new building, complete with 4,000 square meters of white rooms, to study the WAFEC [Wafer Air Flow Environment Container] concept.

The idea for reducing the cost of the installations consists of confining the silicon slices in ultra-clean caissons. The air filtration in the remainder of the environment then becomes less of a constraint. The future 4Mb-Eeprom and 16Mb-SGS-Thomson memory circuits, developed as part of the JESSI program, should be produced with this process. But the LETI investment amounts to Fr150 million. And it provides only the bare walls, not the interior equipment!

At such high levels of expenditures, going it alone no longer makes any sense. LETI and Cnet acknowledge this. But how to cooperate and to what extent? There, the responses diverge. "Difficult to imagine that two public laboratories cannot come to an agreement, whereas private industrial firms, although competitors, have already agreed to work together," exclaims Jacques Lacour. The LETI manager willingly imagines the creation of a management committee common to both partners. "But," he recognizes, "we are examining various scenarios, and nothing has yet jelled."

On the Cnet side, prudence is tinted with a slight wariness. Cnet, let us not forget, falls under the jurisdiction of France Télécom and this richest government agency in France is too accustomed to tapping its profits "in the general interest" to run head first into cooperative projects. In this specific case, Cnet fully intends, first of all, that its objective will not be lost from sight. "Our mission in microelectronics," says Jean-Pierre Poitevin, "consists of producing circuits sufficiently innovative so that they are not obsolete when the future telecommunications devices into which they are to be integrated will themselves be designed." The first preoccupation of the

Cnet manager is that France Télécom will be ensured as to the permanency of its supplies of special circuits that are impossible to find on the market. That being the case, its main concern is to optimize the coming investments. It is of the opinion that simple cooperation, such as sharing men and equipment, will not be sufficient. "Only an integrated program will succeed," he assures.

Three scenarios are being studied at Cnet and will be submitted very shortly to the general manager of France Télécom, Marcel Roulet. And the fundamental decisions and strategic options will be arrived at between now and the end of the year.

First Hypothesis: Cnet continues as before. It will then be required to find Fr500 million, very fast.

Second Scenario: Horizontal integration, work in common of organizations and financings of like business around a given technological unit. In this case, the entire research-development chain is integrated, starting with basic research, circuit design, and production science, up to the pilot shop. It can involve cooperation with LETI but also, and why not, with German and Italian telecommunication research centers.

Lastly, Third Choice: Vertical integration, each one concentrates on its first objective. Cnet would limit itself to the design of state-of-the-art circuits, others (LETI?) to production science. And this organization would directly involve a silicon foundry: a private industrial firm. In this case, each component of the chain is completely subordinated to the others, but each can work in depth in its specialty. For the time being, no scenario seems to prevail, neither in the organizations involved nor in the government agencies which are closely following the matter. Philips and Siemens, themselves, decided a long time ago; they are integrating the whole chain, from basic research to industrial production, in return for colossal expenditures: Fr5.5 billion for Siemens, Fr4.5 billion at Philips. The French part of JESSI is only beginning to be organized.

SCIENCE & TECHNOLOGY POLICY

ANVAR: R&D Agenda for 1989 36980141 Paris AFP SCIENCES in French 26 Jan 89 p 3

[Text] Paris—The president and general manager of the National Agency for the Application of Research (ANVAR) indicated 19 January that ANVAR would be "resolutely open to Europe and even more selective" in 1989. "We will give first priority to technological quality and I would not be embarrassed to announce that fewer projects had been supported by the Agency in 1989 if that were the case," added Mr Bertrand Larrera de Morel. He specified that his organization would have an overall budget this year of Fr1.25 billion, up 8 percent over 1988.

Loans for innovation, created by ANVAR in 1979, are principally directed toward small and medium businesses which want to develop really new, high-technology programs, where technical and commercial risks are great. In 1988, 90 percent of the loans made involved companies with fewer than 500 workers.

Last year, 1,800 companies benefited from these advances, granted at zero interest. Reimbursable over a 3 to 5 year period if projects are successful, they can cover up to 50 percent of the cost of the project and are granted by decision of the Agency's 24 regional delegates. "On the average, over the last 10 years half the innovation programs have ended in technical and commercial success," continued the ANVAR CEO. The Agency also facilitates the transfer of research results from laboratories like those of the CNRS [National Scientific Research Center] to industry.

In 1989, approximately 1 billion francs will be allocated to entrepreneurial projects, from 70 to 90 million to support research companies under contract, and 50 to 70 million to technology transfers.

In addition, Fr90-110 million will be earmarked for the development of aid to small and medium industries in recruiting young researchers. This "pilot operation," launched last May, has already made it possible to hire 242 people and was, for many companies, their first brush with applied research.

In order to make France more open to Europe and the world, ANVAR will step up companies' access this year to foreign laboratories, notably through the Eurotech program. This program was created last September and is a joint project of ANVAR and four organizations: English, Dutch, German and Danish. ANVAR will also promote partnership agreements with foreign small and medium industries.

"It is vital that the European "meshwork" between banks, industries, and research laboratories be developed," affirmed Mr Larrera de Morel. In his view, it is also important to better inform French companies—which "often are not aware of them"—about the forms of Community aid from which they can benefit. Finally, funding of innovative projects by banks—10 establishments signed an agreement with ANVAR to guarantee their risks—"will be stepped up in 1989, as desired by the public authorities," concluded the agency's CEO.

Commission Advises Rejuvenation of Scientific Population

36980155 Paris AFP SCIENCES in French
23 Feb 89 pp 1-6

[Text of Crozier Commission Report, preceded by AFP SCIENCES commentary]

[Text] Paris—French researchers are aging. The problem needs to be addressed now. Addressing in these terms the current aging of the French researcher population, the

most recent report of the CSRT [Superior Council on Research and Technology] Commission on Scientific Employment will undoubtedly make waves when it becomes known by the small world of French research.

According to the report, "the aging of the researcher corps as a whole represents a major risk for the scientific development of France, and consequently for the development of its industry and its economy." It points out that no visible solution has appeared and that only a comprehensive study by a select committee of scientific notables of international stature, limited to from 3 to 6 members, can be expected to "examine in their entirety the problems posed by the development of the system of human resources required for research over the next 20 years."

This report was prepared during 1988 by the commission presided by the sociologist Michel Crozier, director of research at the CNRS [National Scientific Research Council], and forwarded on 21 December to Mr Hubert Curien, minister of research and technology. The CSRT did not approve it but nevertheless authorized its publication, by decision reached on 15 February.

The problems brought forth by this report, and the impact they will have on the future of French research, hence on the country's economy, warrant front-burner attention as soon as possible on the part of the decision-makers responsible for addressing them and developing the required solutions.

In his preface to the report, Mr Jean-Pierre Causse, vice president of the CSRT, points out that the report "analyzes in considerable detail what it judges to be the grave consequences for French research, given the aging of the population of French researchers, and the extraordinary difficulty involved in bringing about a change in the situation." Mr Causse adds: "Although agreement is virtually unanimous on the findings of fact, the conclusions advanced by the Commission and the method of approach it recommends have encountered reservations, indeed opposition, on the part of some members of the CSRT." A debate is certain to take place, given the known positions of the unions.

At the Ministry of Research, while it is pointed out that consideration of the problem was indispensable, the nature of the report is being emphatically characterized as "personal opinion," "somewhat severe," and "not a revelation" for the specialists. It is being added there that many of the points addressed by the report have already been acted upon through specific measures, and that the Ministry would prefer that these problems, which are not confined to France alone, be addressed as a whole at the European level.

The text of the Crozier Report follows:

The CSRT Scientific Employment Commission solemnly invites the attention of the Minister and of the governmental authorities as a whole to the problem of the accelerated aging of France's researcher population during the past 15 years, from the standpoint of its critical importance to French research.

Everything it has been possible to do in the past, or that is being sought to accomplish with a view to the future, whether it be in terms of general funding, or of promoting high-priority activities, or of developing applications of research, depends strictly and incontrovertibly on the quality of the researchers, their availability, their openness, and their dynamism.

It will be to no avail whatever to make more credits available or even to enact excellent measures to strengthen ties between research and industry or to further the use of scientific results, if the human resources are not truly active and enthusiastic. For research, even more than for any other intellectual activity, the quality of the human resource is the determinant. Effective research is not done by effective programs but by effective researchers.

And yet, while public and private officials all stress the decisive importance of research for the future of our country, no one thus far appears to bring sufficient attention to bear on the human problems involved in its development and essential to its success: As if human beings were interchangeable and as if all that is needed to obtain the expected results is to set good priorities and fund them.

The human problems in research extend unquestionably far beyond that of aging. The researchers' career opportunities, their mobility, organization of the laboratories, the prospects for and models of relations and exchanges with industry and the universities: These are all elements that determine the quality of the support provided for individuals and teams by an environment. But the abrupt change that took place in the age composition of the researcher environment towards the end of the 1970's is going to dominate all other problems over the next 15 years.

A human group consisting of a vast majority of aged persons tends naturally to stay within its limits and structures and to shun adventure. True, many individuals remain extremely creative—and this is readily verifiable—and some of them can be ranked among the driving forces behind scientific development. But the load-bearing quality of the environment as a whole becomes increasingly impaired.

All the big private management organizations know this and strive to maintain a constant and sufficient inflow of new blood. And an activity such as research—which is essentially a nonconformist activity of discovery, of investigative questioning of the conventional, of basic drive and taking of the lead—is even more vulnerable,

and greatly so, to sclerosis. Thus, the aging of its researcher corps as a whole represents a major risk for France's scientific growth, and consequently for the growth of its industry and economy.

Everyone agrees that France's future depends largely on the quality of its scientific and technological growth. But everyone appears to ignore the fact that this quality depends every bit as much on the human element as on funding. If we do not intervene very soon on a massive scale, the onset of inversion of the demographic curve within 10 or 15 years will find France not only at risk of losing its place in the lead platoon of major scientific nations, but also devoid of the means of training, of staffing and of development that would enable it to come from behind and overtake the lag it has incurred. Its economic growth will be unquestionably and drastically stunted.

Findings

The figures the Scientific Employment Commission has compiled are extremely eloquent in their very simplicity. Although the ratio of researchers under 40 years of age remained steadily higher than, or at least equal to, 60 percent throughout the 1950's and 1960's and into the 1970's, it declined rapidly during the remainder of the 1970's and dropped below 40 percent during the 1980's.

Currently, the average age is 43 and 1/2 years. The rate of natural attrition (retirements and deaths), on which the prospects for renewal currently depend, is presently at its lowest, or 13 percent per annum, and will rise only very slightly over the next several years. True, its rise will accelerate beginning in 1992 and finally attain its "normal" rate of 25 percent per annum within 15 years. But given the size of the present mass of researchers, the composition of the whole from the standpoint of age will change only very slowly at best. The rate of voluntary departures to be added to those owing to retirements is also very low, and, to the extent that an aged population is naturally much more stable, there is not the least chance that this rate will increase.

If the rate of new entries into the research agencies does not change significantly, or if scientific employment policy does not change, the researcher population's average age within 10 years will be 45 and 1/2 years, with 63 percent over 40 years of age (versus 62 percent at present) and 37 percent (versus 22 percent at present) over 50.

Even in the event of a very substantial outlay to smooth out the age pyramid through early hirings carefully spread over time, the age composition of the whole will not be changed. That is, the hirings will not restore to French research the dynamism it had during the years 1950-1970, when the percentage of the under-40 researchers was constantly greater than 60 percent. Indeed, such hirings would be taking place in an environment likely to be somewhat closed and unreceptive to

new ideas. Contrary to the ideas that have been received in this regard, there are hardly any differences on this point among the disciplines.

These facts would already be disturbing for the future of an enterprise or even that of a civil service. But when the activity involved is of a nature as particular as that of research, requiring creative and nonconformist capabilities, they are nothing less than catastrophic.

The Commission is aware, of course, of the danger inherent in reasoning solely on a quantitative basis and in consequently enacting hasty regulatory measures such as lowering the retirement age, mandatory mobility, or a staff-retirement and pension law modeled on the military one.

Before seeking quick-fix, technocratic solutions, therefore, the Commission considers it essential that the responsible heads, first of all, followed by the researchers and the public as a whole, understand the fundamental elements of the problem. The Commission, for its part, plans to proceed along the following lines of thought:

1. All international studies show that for researchers, on average, individual creativity is greatest between the ages of 25 and 35 years, creativity not being taken to mean realization, development, or follow-through, but rather the germination and budding of new ideas, initiation of breakthroughs, and original discoveries. Tomorrow's successes are achieved not by pursuing present-day recognized activities, but by cultivating, maintaining and developing the breeding ground that will produce the necessary potentials for growth, and whose sole guaranty is the presence therein of active and enterprising youths.

2. The simplistic demographic view which consists of merely surveying the characteristics of individuals is entirely insufficient. Individualists though researchers may be, they are every bit as much, and if anything more so than others, tributaries of the environment in which they live and of the organizational system of which they are a part.

The effect of aging must therefore not be measured by the performances of individuals detached from their context. An aged researcher in an open environment, strongly stimulated by younger colleagues over whom he has responsibility, will be much more creative than he would be in an environment of colleagues of his own age with whom he would merely continue the debates in which he had already become an expert. On the other hand, a critical mass of aged persons creates a climate that weighs heavily on the behaviors of even the youngest persons among them.

3. Even more serious is the effect on the structures. The present situation is not good. Organizations that do not renovate themselves either through mobility or through

generational influxes, become sclerotic much more rapidly. This is particularly true of activities that, like research activities, are qualitative. A research organization cannot remain creative if its human element ossifies. This does not mean that it will not produce respectable results. But it means that it will no longer blaze new trails and will no longer be a sufficiently stimulative driving force.

Objectives To Be Attained and Strategy To Be Implemented for Their Achievement

In the face of a situation of this gravity, traditional solutions turn out ineffective or are too costly, or appear unbearable to the community.

Owing to the inertia of demographic phenomena, augmenting the number of entries into the Government agencies without changing the rules that govern personnel career opportunities—and short of resorting to investments so massive as to seem a priori impossible—can only have very limited effects.

If instead of the present entry rate of 3 percent (1 percentage point of which represents new creations), this rate were raised to 5 percent—that is, by tripling the present rate of new creations—it would still take 8 years for this outlay to translate into a tangible effect on the age pyramid. Meanwhile, the new entrants would have, to a large extent, become socialized and absorbed into the dominant culture. To achieve a sufficient qualitative change would require raising the entry rate to at least 8 percent; that is, multiplying by 6 the number of creations of new positions. For the moment, this seems unthinkable under the current financial constraints.

Neither is it possible to impose sufficient mobility, which would have to be considerable to have any effect. It would be ill-received, and all the more so because the current population's only experience has been with public-sector research.

A staff-retirement and pension law is possible, of course, but for it to have a chance of being accepted would require a profound transformation of the current environment. To render departures "attractive" involves outlays. Some success can be expected. But the risk is that precisely the most conformist will be the least attracted by them.

Considering these difficulties, the Commission has therefore sought to reason from a different viewpoint, returning the problem to the larger context of the research system as a whole and taking into account the possible dynamic of development in time. Based on this approach, it has seemed to the Commission that:

1. The rejuvenation considered indispensable in preparing for the future must not be approached by considering solely Government researchers, since within this too constrictive context the problem is not amenable to an

acceptable solution. On the other hand, if the research system is viewed comprehensively, including all the other persons, doctoral candidates, and post-doctorate researchers under contract and actually engaged in research projects, the constraints appear less severe and the possibilities of a meaningful breakthrough more conceivable.

2. If the perspective is to be changed in this manner, however, it is important not to be deluded by statistical appearances. For, only to the extent that non-Government researchers actually play a substantial active role in the dominant Government research system will the proposed—and much easier—increase in their number indeed produce a significant rejuvenation of the system as a whole.

3. In this regard, the problems of recruiting and orienting doctoral candidates, and of training young non-Government researchers but also Government researchers, appear crucial. The quality of their solution will determine the quality of the rejuvenated research system of the years 2000-2020. The Commission finds that careers as researchers are appearing less and less attractive to highly talented youths, not only from the standpoint of low pay, but also and above all from that of the antiquated nature of the environment. Only a creditable human resources policy can change its image.

4. The research system can also be rejuvenated and training improved by mobility between public-sector research and private-sector research, between universities and Government research agencies, and between French and foreign laboratories. But to achieve sufficient real advances, there must be a change in the system of relations between institutions and environments that, generally speaking, refuse to cooperate. A major prior study must be undertaken, if the intent is to create the conditions necessary for rendering mobility easier and more attractive.

5. The role of the laboratories and research teams must also be restudied, inasmuch as it is within these active research cells that the socialization of the young non-Government and Government researchers takes place. For rejuvenation to take place, these personnel-intensive units must be looked to, to provide renovation, training, orientation and mobility.

6. Each discipline or subdiscipline is in effect a small system of its own, with its own, often complex, regulations. Their diversity is such that no general measure can take them all into proper account. Each environment must be studied separately from the standpoint of the indispensable conditions for its rejuvenation, and its future must be prepared, at least by groups of disciplines, taking into account its recruitment capacities, collaborative networks, and future potentialities.

7. The development of a human resources policy aimed at restoring dynamism to the human environment of research cannot succeed unless it is combined with a renovation of the structures and with the creation of new units capable of responding to the incessant proliferation of scientific and technical advances.

A High-Level Select Committee Indispensable to Preparation of Strategy Change Guidelines for Reversing Givens of Present Situation

The Commission explored various possible approaches in these regards. It very quickly realized that each new proposal that seemed to emerge from the examination of a partial problem faced insurmountable constraints immediately, stemming on the one hand from the interdependence of all elements of the system, and on the other hand from the extraordinary difference between the specific cases of each discipline, group of disciplines, or even speciality.

Hence, it appeared to the Commission that for it to offer solutions or even mere suggestions that would be acceptable, even if only as a starting point, would be totally impossible without involving a detailed professional study of another nature.

The Commission recommends, therefore, that, given the magnitude and pressing nature of the problem, a Select Committee of scientific notables of international stature be appointed and assigned the mission of examining the array of problems posed by the development of the system of human resources that will be required for the research effort of the next 20 years, in each of the problem areas cited in this report.

The Commission also recommends that the proposed Select Committee, consisting of 3 to 6 members, be given the time and the funding necessary to have the indispensable surveys made and to have specialists and experts work, free of all administrative constraints and tradition, on the detailed study of the problems and on the emergence of new innovative solutions. The Commission further recommends that the Select Committee's mission not be limited to the research activities of the major scientific establishments, of the universities, and of the big industries, but that it extend to the examination of the human problems posed by training and recruitment (a policy of topics and allocations of topics), the operation of public-sector research contracts and relations with the business environment, the future prospects currently available to researchers, and the constraints that hinder their development.

SUPERCONDUCTIVITY

Italy: Ansaldo, CNR Develop First Superconductive Engine
MI890169 Rome FINMECCANICA NOTIZIE
in Italian 31 Dec 88 pp 8-9

[Text] Ansaldo Ricerche and ITM [Institute for Non-Traditional Metallic Technologies] of the National Research Council (CNR) have developed Italy's first

superconductive engine, which employs a particular property of the new ceramic materials. Through the use of high critical temperature superconductors featuring transition temperatures of approximately -183° C (higher than that of liquid nitrogen), the researchers succeeded in developing the prototype of a Meissner effect electric motor. The Meissner effect lies in the expulsion of the magnetic field from within the superconductors; any material endowed with this property is referred to as diamagnetic.

One characteristic of diamagnetic materials is that they are subject to a repulsive force when placed in an external magnetic field. In particular, when a magnet is placed under a superconductor, the superconductor rises until the magnetic repulsion force equals gravity (levitation). This principle can be applied to a simple motor, consisting of a rotating disk unit fitted with conventional electromagnets powered by current impulses delivered through a traditional manifold, and a stationary unit, composed of eight small cylinders made with a synthesized yttrium barium copper oxide mix developed by ITM. These ceramic cylinders are immersed in liquid nitrogen contained in a simple cryostat of polystyrene foam.

The magnetic field generated by the single electromagnet interacts repulsively with the (diamagnetic) superconductor interfacing, thus generating a mechanical torque which gives the engine rotation speed which is approximately 60 rpm for the prototype.

Ansaldo Ricerche and ITM are implementing a research and development program based on the Meissner effect in an attempt to generate the maximum mechanical torque that may be obtained from the interaction of a superconductor with the magnetic fields that induce the effect. The engine is an exercise in the use of new high-critical-temperature superconductor technology, and marks a first step in an industrial development program involving universities, business, and national research institutes.

TECHNOLOGY TRANSFER

Italian-Soviet R&D Agreements Signed

Agreement With IRI

36980159a Rome *NOTIZIE AIRI* in Italian
Nov-Dec 88 pp 19-20

Article: "IRI-USSR Joint-Research Agreement"

[Text] Pursuant to talks begun as far back as 1970, a 5-year agreement on the developing of research was signed by the IRI [Institute for Industrial Reconstruction] with the Soviet Union. The agreement was initiated by the IRI's general manager Antonio Zurzolo and by the first vice minister of the USSR's Science and Technology Committee Ivan Bortnik. It provides, among other things, for the creation of Italo-Soviet scientific research

laboratories and consulting organizations in the engineering and design field, as well as the exchange of technical information, with missions to be sent immediately by both parties.

Zurzolo pointed out that the agreement was reached within the framework of renewed cooperation between Italy and the USSR, begun during the ICE Show in Moscow titled "Italia 2000," and as part of the major research outlay the IRI Group has made over the past several years.

Over 10,000 persons are currently employed in the Group's research and technological development sector—said Zurzolo—and the level of financial resources being committed to this effort exceeds \$1 billion annually. Plans for the 4-year period 1988-1991 provide for the spending over \$5 billion (approximately 7,000 billion lire). "This outlay," continued the IRI's general manager, "is centered mainly on highly technology-intensive activities, such as telecommunications, electronics, data processing, energy, aerospace and sophisticated facilities engineering.." According to Zurzolo, the IRI has succeeded, over the past few years, in "gradually shifting its exports from the mature sectors and lesser developed areas to the technologically developed sectors and industrially advanced zones." The group's exports in the high-technology sector and to expanding markets amounted to 66 percent of its total exports in 1987, versus 45 percent in 1981, while the level of its penetration in the industrialized countries rose, during the same period from 40 percent to 55 percent of the IRI's foreign billings.

Other Agreements

36980159a Rome *NOTIZIE AIRI* in Italian
Nov-Dec 88 pp 32-33

[Article: "Italy, USSR Sign Scientific & Technological Cooperation Protocol"]

[Text] A joint-research protocol covering a vast array of topics and projects was signed in Moscow on 9 December at the conclusion of the fifth meeting of the Joint Italo-Soviet Commission for Scientific and Technical Research.

The Commission "found that the radical economic reform under way in the USSR and the restructuring of its foreign trade relations management are creating favorable conditions for the development of relations between firms, and between scientific institutions, and for the exchange of scholars and experts, and the setting up of new forms of cooperation."

In the field of basic research which, for Italy, is of interest to its CNR [National Research Council], its Accademia dei Lincei, and its National Institute of

Nuclear Physics, the protocol provides for studies in medicine and public health, oceanology, peaceful use of nuclear energy, environmental protection, and space research.

The Commission also approved the overall plan and topics of the 1989-1998 10-year program of scientific and technical cooperation between the two countries.

Referring to the agreements signed in Moscow in October with the minister for scientific research, the Commission cited the importance "of the signing of documents enabling the creation in the USSR of the joint Italo-Soviet firm 'International Center for Training and Economic Research,' founded by the Italian economic research firm Nomisma on the one hand, and the Soviet State Committee for Education (Plekhanov Institute) and State Committee for Science and Technology (UNIEPRANT) on the other."

Added to this, the Commission cited the important work being done in this field by the Soviet agencies concerned, in cooperation with the Bocconi University's School of Business Management and the University of Genoa's ENFAPI-SOGEA. The Commission also "took official note of the recent talks in Moscow between Unionquadri and Soviet training institutes, with a view to organizing professional training programs and courses for the management staffs of Soviet firms."

In conclusion, the Commission expressed its anticipation of a broadening of cooperation between the universities of the two countries, particularly with respect to "integrated action" programs (research programs and projects to be carried out jointly by the various universities).

AEROSPACE, CIVIL AVIATION

Joint Soviet-Bulgarian Space Mission Yielding Results

22020006 Sofia RABOTNICHESKO DELO
in Bulgarian 12 Dec 88 p 3

[Article by Prof Boris Bonev, Director of the Institute for Space Research at BAN [Bulgarian Academy of Sciences]: "The First Results from the Shipka Program are the Foundation for Future Space Projects"]

[Text] The Shipka science and technology program for the flight of the second Bulgarian cosmonaut was completed in June of this year. It is known that this program was continued and developed further on board the Mir [Peace] orbiting complex even after the Bulgarian-Soviet space flight. All Bulgarian equipment is still in place on the station. Some of it was used in a number of scientific experiments by the Soviet-Afghan team. Since the crew included a physician, cosmonaut Valeriy Polyakov, the Shipka medical and biological studies were carried out during continuous space flight. The new team on Mir, now in orbit together with the Frenchman Chretien is trained to work with our equipment.

Time was needed to process experimental data and now the first results from the implemented scientific program are reflected in the preliminary reports. The goal of a preliminary report is to compare the actual implementation of the program with the one planned, to provide a general evaluation of the experimentation results, and to specify the methodology for future work in 1989.

Preliminary analysis of the results characterized the first conclusions concerning the accomplishments in various fields.

In the Field of Space Physics:

The Rozhen astronomy complex has functioned according to technical requirements. The planned experiments have been fully carried out and high quality images have been obtained. Some program improvements have been made in connection with the Soviet-French flight. A Bulgarian observation program will be implemented to facilitate the processing of stellar systems long-term orientation characteristics and work with the optical equipment on the Mir station.

The results from experiments with the Parallaks-Zagorka instrument require additional handling. Final data analysis will be made after the completion of a forthcoming experiment on board.

Joint work on the Terma device and the Zora [Dawn] system was carried out during the Soviet-Afghan flight with duplicate software. The first diskette, which—as we

remember—was lost during the Bulgarian-Soviet expedition, was found on board later after the completion of Alexandur Alexandrov's flight. The data is identified simultaneously by Bulgarian and Soviet specialists.

Remote Sensing Methods to Study the Earth within the framework of the Georesurs program were provided by the regular operation of the Spektur-256 spectrometric complex. The planned measurements have been made and photographs of the predetermined regions and areas have been taken. The data obtained is ready for processing and some new and interesting results are already emerging. It is anticipated that the Soviet party will send a second big batch of photographs from the joint flight. According to plans, the experiments with Spektur-256 will continue within the framework of the Interkosmos program.

Space Medicine and Biology:

Preliminary processing of the results from ten experiments carried out during the Soviet-Bulgarian and Soviet-Afghan flight is completed. With regard to quality, the results are a new contribution to science according to specialist evaluation. The improved software for the Zora system will make it possible to process an increased amount of material obtained on board. Future utilization of this system of ours will be related to information telemetering from space.

The publication of data obtained from radiation monitoring experiments on the Mir station is foreseen.

The Scientific Program on Space Materialogy was completed fully during the flight. The capsules obtained from the space and simultaneous Earth experiments—VOAL, Struktura, and Kliment-Rubidiy—were cut open and subjected to microanalysis. The conditions of weightlessness have affected the samples of the new materials, which have better properties according to initial comparison parameters. Many specific studies for each sample will follow so that a fuller picture of the physical and chemical properties of the materials can be obtained.

Studies and processing of the materials according to the Shipka program will be continued in 1989 jointly by Bulgarian and Soviet specialists. The general and final report of this program will be drafted and approved by both parties during the third quarter of next year.

The space program created by the efforts of Bulgarian scientists, engineers, and specialists for the flight of our second cosmonaut has already given its first scientific results. After analysis of all obtained materials, its high scientific value will undoubtedly become apparent. Happily, Shipka's positive evaluation before and during the joint Bulgarian-Soviet flight was also confirmed afterwards. With the persistent work of scientific-technical

resources and with long-term principles at stake, this program has established our country as a desirable partner in the Soviet space program by fulfilling significant future space tasks.

Conditions already exist for the creation of a national space program in which research could be used in almost all areas of life in our country and which could become a catalyst in the development of science, industry, health care, communications, transportation, and education. Developments in this comprehensive program will be our national treasure. The economic foundation of cooperation with the Soviet space program will allow us to ensure a good return on resources invested in space research.

But to accomplish future space endeavors which are in step with world trends, it is necessary to include many more specialists and organizations and to use available material and technological resources efficiently. This is necessary to achieve new successes in the conquest of space and to transfer space resources to every-day life on Earth.

The role of the Institute for Space Research at BAN will be to an increasing degree responsible for the fulfillment of these tasks. In this sense its accelerated orientation toward new trends with regard to the comprehensiveness of space research is an objectively necessary and urgent task.

COMPUTERS

New Software Programs At Hungarian Technical Development Cooperative
25020038a Budapest COMPUTERWORLD/
SZAMITASTECHNIKA
in Hungarian 14 Jan 89 pp 1-2

[Article by Endre Mogyeri: "MicASZ And The Others"]

[Text] The Technical Development Small Cooperative for Microsystem Computer Technology announced a price reduction and new software products at the end of last year. All three programs are intended to help orient leaders of managing organizations and lay better foundations for their decisions.

The purpose of the MicASZ system is to make it possible for leaders to follow the efficiency and profitability level, property situation and cost structure of an enterprise and to follow their development. Data are stored and processed on the basis of a "rolling 5 year" perspective. The program also ensures the storage of the chief data for the enterprise balance reports in a uniform system even if the forms of the balance report change. It can also be used to prepare the World Bank balance, income indexes, a multi-stage liquidity balance and liquidity analyses.

In addition to the two program disks, the small cooperative also provides a data disk which contains the balance framework for the first half of 1988. Additional balance frameworks can be purchased when making use of a follow-up service maintained for at least 5 years. The price of MicASZ is 84,000 forints and the follow-ups cost 12,000 forints each.

The Hatas'89 [Impact'89] and MEGA programs were prepared to solve related tasks. The former examines the impact on management of the 1989 regulator changes for industrial enterprises and the latter does so for agricultural organizations.

Hatas'89 makes possible the planning of expenditures and receipts and prediction of the expected economic results taking into consideration the joint effect of the changes and enterprise leadership measures, in several plan variations. About 50 firms have bought the 1987-1988 versions of the program and an additional 150 users have made use of the possibilities of the product as a service of the Mentor Small Cooperative.

MEGA realizes similar functions for leaders of agricultural organizations. The makers of the software promise that they will continually follow those economic guidance decisions the effects of which may be reflected in the operation of the programs. So the small cooperative also provides a follow-up service for both products and within this framework they will put in regulator changes affecting use of the programs up to the first of September 1989 (changes in accounting procedures, appearance of new taxes, etc.).

The Hatas'89 program costs 32,000 forints (follow-up 4,000) and MEGA costs 28,000 forints (follow-up 4,000).

Experts at the Financial and Accounting College prepared the models for the products, which can be run on IBM PC/XT and AT compatible machines. We already reported (in our issue No 22, 1988) that Microsystem is starting to sell a Hungarianized version of the WordStar text editor already being handed around and up to 31 December will give amnesty to owners of pirated copies. Zoltan Szamoskozy, chief of the customer service of the small cooperative, said that unfortunately interest remains below the expectation. So far there have been about 100 orders for the product, half of these are new buyers and the other half are making use of the "amnesty." It appears that a large number of the enterprises are not assuming the "discredit" going with the amnesty.

The Hungarianization of WordStar has been completed and experts from MicroPro are doing the testing. So sales started in the second half of December.

The price of the program is 35,000 forints, which includes the original and the supplementary Hungarian documentation. The price of an "amnesty copy" is

26,000 forints. If 5-10 copies are purchased, the price each is 27,000 forints, and if more than ten are purchased, the price is 23,000 forints. According to the license fee deal, the user with one complete copy can get user rights for any number of machines (he gets numbered disks) and then the price is 17,000 forints each. A demo version of WordStar will be sent free of charge to those interested.

Among other things WordStar makes possible visual display of proof text (Advanced Page Preview), preparation of tables of contents and indexes, editing of footnotes, transfer of data from spreadsheet management programs and chaining of files. Good news for users: WordStar also uses accented characters according to the CWI code table so our standardization efforts are spreading on the market.

In addition, the program can run on any IBM PC/XT or AT compatible computer under DOS 2.0 or higher operating systems with 384 kilobytes of memory (512 for Advanced Page Preview).

Another item connected with the small cooperative is that they have opened offices in Pecs and Györ, where the same services will be available as at the Budapest center.

Hungarian Research Institute Designs Circuits With Programmable Array Logic
25020038b Budapest
COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian 14 Jan 89 p 15

[Article by Zsuzsa Porkolab, MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]: "SZTAKI Gets Into The Act"]

[Excerpt] At our institute we have been designing circuits with PAL's for about 5 years. It became necessary for us to prepare a burner as well. This PAL programming system burns the most popular 20 and 24 pin PAL's made by MMI and the similarly burnable products of Texas Instruments and National Semiconductor.

The hardware consists of two units—a control card, which can be plugged into an IBM compatible PC, and an adapter card, which is connected to the control unit by a tape cable. The box of the adapter contains the 20 and 24 pin socket into which the PAL to be burned is placed.

On the one hand the software creates a link between the PC and the control card and on the other hand it loads the registers of the adapter in accordance with the burn algorithm and starts the burn and test cycles.

In order to facilitate the programming of PAL chips and transfer of the data to the computer we also prepared a high level translator (PALASS) and simulator

(PALASYM) program. With these we can formulate the desired logic functions in the form of Boolean algebra equations, truth tables or state transitions and they make possible a functional check of the logic net as well. With the aid of a conversational functional PAL simulator, PALASYM, the user can define various sequences on a picture like a time diagram. It is enough to give the input values; the program automatically generates the outputs. It also indicates indeterminate outputs. In a multiwindow environment one can simultaneously observe the sequence and logical equations to be simulated, showing the current values of the variables. The PALASYM uses the JEDEC file format to define the logic net so it can be used with any PAL translator. [passage omitted]

Hungarian Image Processing System
25020034 Budapest MAGYAR ELEKTRONIKA in Hungarian No 1, 1989 pp 22-26

[Article by Mrs Eva Nikodemusz Szekely, Istvan Renyi and Janos Miskolczi: "Image Memory of the ATLAS-90 Image Processing System"]

[Excerpts] The speed and utility of every digital image processing device are determined primarily by the organization of its image memory, the fast and versatile access to it. This is especially true when fast processing of a large mass of data is required, as in the thematic processing and interpretation of multispectral space pictures. In issue No 8, 1988, of MAGYAR ELEKTRONIKA we could read an article by Istvan Petocz about remote Earth sensing, about the ATLAS-90 image processing system developed jointly by HT-KFKI [Communications Engineering Cooperative-Central Physics Research Institute]. In our article, closely related to the foregoing, we will deal in more detail with the image memory of this equipment. [passage omitted]

The control computer for image memory—and for the entire ATLAS-90 system—is the KFKI IPC [Image Processing Controller], a single card minicomputer which is instruction compatible with the PDP 11/44. This computer and the floating point processor available as an option are both microprogrammable. [passage omitted]

The Microprogram

An entire software system, developed at the KFKI, is available for development of microprograms. There are symbol table translating, microprogram translating and microprogram chaining programs, plus a debugger that loads and traces the microprogram.

Naturally we can also burn the microprogram into PROM; in a finished system it is sufficient to use a read-only microprogram store.

The routines ensuring basic operation of the system include, for example, routines for simple and enlarged display, refresh of storage modules and sequential and random writing/reading, plus microprograms for executing commands reaching the MEMBUS.

In addition there are a few subroutines, a good example of which is, how to best divide the several functions between the micro- and macroprogram, when solving some task. For example, there are various test programs—we will speak of these later—a program ensuring transformation between various pixel information depictions and a program for “broken value” magnification. We need a conversion program if the 8 bit resolution is too small (e.g. in the course of FFT algorithms). It is more suitable for the IPC if the 16 bit data can be addressed in one word, and this means two neighboring pixels in image memory. And it is best for hardware processing, if the lower byte is in one and the upper byte in another image plane. The conversion microprogram does the rewriting, there and back, between these two numerical depictions.

The hardware can enlarge the image elements, with whole values between 2 and 16, by repeating pixels or lines. But in some matching tasks it may also be necessary to have finer magnification between values 1 and 2. A special microprogram takes care of this. Starting from a given origin address it reads the pixels of the image to be enlarged one by one and fills in the “missing” pixels by interpolation between neighboring pixels or by repeating one of the pixels.

The Image Planes

There are two $512 \times 512 \times 8$ bit image planes in one storage module (on one card). We can see a simplified block diagram of the card in Figure 3. When displaying the storage block one actually reads/writes in 32 bit words—because of access times—and we transform these into bytes following one another by one pixel time (75 ns)—or vice versa. The sequential reading can be to one of the four 8 bit output videobuses or to the PL lines going to the pipeline processor. And in the case of sequential writing we can select one of the four 8 bit input videobuses. Random access is also on these buses, from the control, but directly. The storage module receives from the control on an internal system bus (SB) the instructions and initial addresses pertaining to it. The “indicator number” generator of the storage module drives the system bus when we activate the test mode. At such times the module generates a number characterizing the temporal course of some selected signal and the test compares this with a standard indicator number.

We saw how important it was, from the viewpoint of the utility and speed of the system, to perform the several part tasks at the appropriate place. So we put a number of functions out in the storage modules; these include, for example, zoom, scroll and address counting. Another possibility, characteristic only of image memories, is that

the automatic address counting for sequential reading can be not only by line (the X address) but vertical (in the Y direction) so we can read both line and column vectors from the image. In the case of sequential writing it is also possible to mask bits as desired.

The Videoprocessor

In describing the videobuses we saw that their organization makes it possible to perform some operation on data read from one of the image planes before writing them into the other. The videoprocessor is the unit performing such realtime operations.

During operation of the videoprocessor it gets data from the image planes on a 2×8 bit videobus, arriving with a 75 ns clock signal, and after performing the operation puts the data onto the input buses of the image memory (2×8 bit) from which the data can be written into one or more other memory planes. The timing of operation execution is adjusted to standard TV image times. A microprogram running in the memory control performs timing for reading and writing memory planes and for operation of the VP (videoprocessor).

Input for the videoprocessor can also come from outside the videobus, from the A/D converter (e.g. from a TV camera), in the form of 8 bit data. Using the operation execution units of the videoprocessor (8 bit multiplier, 16 bit ALU, step, output function table) we can, for example, perform an operation of the $y_i = f(a_i x_i + b)$ type on a data block of 2×256 K bytes in a single TV image time. Here the x_i data could be, for example, a point in a real image and the a_i an element in a correction matrix. Similarly one image time is needed to mask an area of interest to us with an AND operation from one image—with the aid of image information written into another image plane—or, for example, to multiply the entire image with a constant multiplier. This structure makes it possible to perform noise filtering by averaging the static images arriving one after another from a TV camera. This requires $2^n + 1$ image times in the case of 2^n images. By using this fast operation execution unit we can substantially speed up the running time of many image processing tasks.

Obviously this unit does not exploit all the possibilities offered by the system. It uses only 2×16 bits from a videobus 2×32 bits wide and it does not use the slow motion possibility. But there is a way to slow down sequential writing/reading by performing multicycle operations per pixel during processing.

The Tests

Development of an efficient testing system is a basic condition for operating any highly complex device. Various test procedures are available for every level of the hierarchy to test the image memory and the entire ATLAS-90 system. At the lowest level there is an instrument to test the storage modules; it provides basic signals

and data for the module and checks the data written into the storage block. At the microprogramming level, as well, one can activate various test programs. These include a self-test for the control, a traditional memory test for the memory modules and indicator number generation, already mentioned when describing the hardware, more commonly called a "signature analysis" microprogram. The high level program only initiates all of these and then queries the result, so not only do we relieve the burden on the control computer but also we significantly shorten the time to run the tests. Naturally the microcomputer controlling the pipeline processor and display unit also has its own independently running test programs. So the only task the control computer has, is testing communication between the component units.

The Software

Even a sketchy description of the full and ever expanding program system for the ATLAS-90 would require another article. We note here only that the software managing the image memory makes far-reaching use of the complex microprogrammability of the system.

We have noted already in a number of places that the several tasks can be executed simultaneously at several levels. The multi-level software system follows the hierachic structure of the hardware. A subroutine library, written in high level language, is based on the lowest level microprograms, which the subroutines directly activate. A person preparing user programs only selects elements from this library. Finally, the operator of the system—the interpreter—does not need detailed information about the hardware and software structure of the system; the operations the interpreter needs are performed by selecting from the finished user programs as from a menu.

Figure Captions

1. p 23; Block Diagram of the Microcontrol.
2. p 24; Outline Structure of the Control.
3. p 25; Block Diagram of the Storage Module.

Autobiographic Notes

Mrs Eva Nikodemusz Szekely: I graduated from the Electrical Engineering School of the BME [Budapest Technical University] in 1977, majoring in communications engineering. First I worked in the major department for acoustics development at the Electroacoustics Factory, where I dealt with digital audio technology. I joined the Communications Engineering Cooperative in 1983. Here I handle development of special image processing hardware and microprograms in the Image Processing Department. I have two school age children.

Istvan Renyi: I graduated from the Electrical Engineering School of the BME in 1968, majoring in communications engineering. I have worked at the KFKI since then and am the chief of a group of scientists. In the beginning I dealt with graphic tools for the man-machine link; since the end of the 1970's I have worked on tools and methods for image processing. I participated in the Vega Program as one of the guiders of the television system project. I earned the degree "Candidate in Technical Science" in 1982 in the area of image processing.

Janos Miskolci: I graduated with a major in physics from the Lajos Kossuth Science University in Debrecen in 1964. I have worked at the KFKI since 1972. I have participated in developing various alphanumeric and graphic image displays. Since 1976 I have dealt with the use of microprogrammable microprocessors. In 1980 I defended my candidate's dissertation on this subject. Since then I have used my experience in the area of designing microarchitectures in the area of image processing.

Bulgaria Developing Military Applications of Programming Technology

22020007a Sofia VOENNA TEKHNIKA in Bulgarian
No 1, 1989 pp 1-3

[Article by Colonel Simeon Kralikov: "Development and Application of Software Engineering and Systems"]

[Text] The 13th BCP Congress, the Central Committee plenums following it, and the party's July draft program stressed the very large-scale and complex tasks that must be accomplished in order for society to reach a qualitatively new level by utilizing the achievements of scientific and technical progress. Information and communication technologies play a leading role in carrying out these tasks. In the military world these technologies are applied to develop control systems marked by high speed, reliability, and flexibility, integrated high-accuracy and high firepower reconnaissance in force complexes, efficient training aid resources, etc. It is no accident that in this context BCP Central Committee Politburo member and minister of national defense General of the Army D. Dzhurov stressed at the 16th armywide party conference that during the current stage of development of the armed forces military theory and practice are especially heavily affected by the close association between science, data processing, and computer engineering. According to him, "the changes that have been caused are so deep and extensive as to mark a veritable leap forward in development. The wide use of new technical software and systems which are the source of this close association has been transformed into the chief means of elevating the defensive capability of Bulgaria to a qualitatively new level."

A solid material foundation has been laid in the Bulgarian People's Army for making a quantum leap in improvement in control. A large number of mainframe,

mini, and microcomputers and other electronic equipment items have been introduced. Production of the most modern systems and technological software for them has begun. Hundreds of user programs have been written for mainframe and minicomputers, along with thousands for microcomputers. The transition is being made from individual applications to major software complexes utilizing a single database. The first steps are being taken in simulation of combat operations, development of expert systems and teaching systems, and processing and display of graphic data.

To increase the productivity of programmers' work, the so-called "environments" of system software (technological software products or software applications packages) are being learned. For expert system mainframes they are the products SUBDON (used to create and update large data bases) and DIAPROG, with which applications based on SUBDON are developed. An original application, TSENTUR, is used to create and update databases on minicomputers. For 8-bit microcomputers there are a personal file system, Visicalc, Agroplan, Superplan, Multiplan, and a commander's electronic notebook, and for 16-bit microcomputers there are Microfile-16, LOTUS, etc.

One highly important aspect is that the "environments" referred to enable even non-specialist programmers to write applications programs themselves. Hence programming will gradually cease being a professional specialty. It is possible in this way to overcome the shortage of end user software products. And this is not all. Experience has shown that officers who are thoroughly familiar with a process to be automated and who are computer literate and are equipped with these packages can write more effective end-user programs. In the programming contest organized by the newspaper NAR-ODNA ARMIYA in conjunction with pertinent agencies of the Ministry of National Defense, approximately 80 percent of the microcomputer programs submitted are those of nonspecialists and nearly 25 percent of them are of very high quality. The same phenomenon is also observed in the area of software engineering and systems.

Much software and many systems developed by teams in military units and higher military schools have become working prototypes of products and systems adopted for development by industry. Officers of the G. Dimitrov Higher People's Military Academy, the V. Levski Higher People's Military Academy, and a number of Bulgarian People's Army units have completed such projects. Military specialists participate actively in the work of the teams, collaborating with civilian organizations.

The most prominent feature today is the linking of individual computers and networks representing the systems software and hardware basis for building automated control systems. Chiefly professional programmers are active in this area. The computers of expert systems are linked to each other by means of the ESTEL

4.3 remote processing system. It is a highly efficient Bulgarian network system which is also marketed internationally. The MREZHA system, also developed by Bulgarian specialists, is also used with much success to link together minicomputers of the SM type. Eight-bit microcomputers are linked to local area networks (LAN) by controllers and suitable software such as the Micronet developed at the V. Lenin Higher Machine-Electrical Institute, while a the distributed data link system (communications system) developed at the same institute is used for 16-bit microcomputers.

Military specialists were the first to develop suitable software for data exchange between 8-bit LANs, and army specialists also concerned themselves with this problem for 16-bit computers.

The development of interface (linking) software is of considerable importance in ensuring fuller utilization of the potential of various generations and makes of computers. Mathematician Tsv. Vasilev has mastered a system network architecture permitting interconnection of computers of different makes (ES 1045 and IZOT 14E, 1014E). It is an important step in the direction of creating a global network of computers of a single series.

Special mention should be made of the accomplishments of the team headed by officer Kiselov, which has developed a system for input and output of graphic data to and from a computer, as well as of the success of officers Rudarski and Iliev in the area of simulation.

It would be a difficult task to list all the significant achievements by specialists who are at work on the computer system problems of military data processing and by enthusiasts who, convinced of the advantages of electronic data processing, have developed software in addition to carrying out their everyday duties.

An irreversible process of application of the achievements of military data processing has begun as a result of the support given by the leadership of the Ministry of National Defense and non-specialists in the Bulgarian People's Army. A number of problems remain unsolved in this initial stage, however, with the result that software and systems are not being introduced at a fast enough pace. Following are several examples.

Despite the indisputable success of civilian scientific research institutes and industrial development elements, individual products rather than integrated software and hardware systems are still being proposed. There is no specialized organization which can be charged with developing small or large automated control systems and from which a user can obtain a fully developed software and hardware system. Usually hardware is ordered from one organization, another item of hardware from another, system software products from a third, user applications software from another, and so forth.

Deliveries of computer hardware are irregular. Because of the absence of a broad domestic component base, hardware production requires imports from other countries. There are delays in starting up manufacture of some computer components and the necessary hardware is ultimately delivered behind schedule and not in the desired configuration (with hard disk drives, printers, larger memory capacity, etc).

Hardware is not always of adequate quality. In many cases microcomputers or other devices do not work after they have been unpacked and hooked up and the arduous course of warranty repair must be followed. Because some questions relating to computer hardware repair have not been fully answered, work at all echelons, and especially in military units, is made more difficult. Repairs are currently done by two methods. One is that of resorting to civilian warranty servicing, a very expensive process, and the other that of employing military repair facilities, but the capabilities of these facilities are limited. The problem of building an orderly military computer hardware repair system is by now a very acute one.

There is a severe problem with the quantity and quality of user software. On the average three or four programs have by now been developed for each 8-bit computer in military units. It is not rare for a computer to have only one applications program or for it to be used for games. A State and People's Control Commission has also found costly electronic hardware tucked away in warehouses.

A large number of user programs, especially ones for microcomputers, merely repeat routine calculation and data processing programs. There are only a few optimized programs making use of advanced mathematical capabilities. One can count on his fingers the number of simulation programs and programs for studying specific processes in combat or those taking place in military equipment. Only 10 such programs were offered in the contest referred to above. Work on application of the artificial intelligence languages PROLOG and LISP are only in their initial stage. Difficulties are being encountered in creating finished ("empty") expert systems.

As has already been stated, even non-specialists can use such "environments" to develop software applications. However, these program packages do not always reach officers at the company, battalion, or regimental level.

Special attention must be paid to problems of computer literacy, which is not yet high enough. Officers are required to possess different levels of knowledge, which are determined by preliminary qualification, age, duty position, and certain other factors. At the minimum they must be able to formulate accurately and clearly what they want to obtain from electronic data processing, and then run programs with a microcomputer or terminal. Officers can subsequently learn by themselves how to write applications programs, by familiarizing themselves

with the elements of the operating system of the individual computer and specific program packages. Military personnel with more extensive preliminary training must learn the art of programming more thoroughly, completely mastering the operating systems and high-level languages, including artificial intelligence languages.

The exchange of software products is not sufficiently well organized. Original versions, exchange of which should be developed at major headquarters by groups of professionals, soon become obsolete. Thousands of different programs have been written, and they obviously should be exchanged by arms and services and disseminated among the various troop elements.

All echelons must devote great care to the problems of using computer hardware under field conditions and to securing data while in computers and when exchanged in local networks.

In the age of the scientific and technical revolution, software and hardware resources and systems provide the possibility of raising the quality of national defense to a new level. To carry this out to the fullest extent, all agencies and elements must be mobilized to eliminate the factors slowing down this process.

FACTORY AUTOMATION, ROBOTICS

Review of GDR Machine Tool Industry

23020043 Beijing JICHUANG [MACHINE TOOLS] in Chinese No 12, Dec 88 pp 11-14, 7

[Article by Song Yejun [1345 2814 6874]: "A Look at the GDR Machine Tool Industry"]

[Text]

I. Integrated Complexes

The GDR machine tool industry is subordinate to that country's Ministry for Construction of Machine Tools and Processing Machinery. It employs more than 88,000 staff, has 71 factories, and is distributed among four integrated complexes.

A. The Fritz Heckert Integrated Machine Tool Complex was built in 1970. It comprises 21 machine tool plants, a staff of 31,000, and chiefly produces machine tools for machining box-type components [i.e., casings] and heavy machinery, as for example boring-mill machines, milling machines, flexible machining cells (FMC) and flexible manufacturing systems (FMS). At its Machine Tool Industrial Research Center there are 1,600 designers, craftsmen, and management personnel.

B. The 7 October Integrated Machine Tool Complex comprises 14 machine tool plants, a staff of 22,000, and primarily produces machine tools for machining components which, geometrically, are solids of rotation. Among its products are gear wheel machining tools, lathes, internal and external grinders, FMCs, and FMSs.

C. The Herbert Warnke Integrated Complex comprises 17 plants and a staff of 20,000. Its chief products are plate machining equipment, injection machinery, production lines, and FMSs. Its Metals and Plastic Machining Technology Research Center has 450 high- and mid-level research personnel.

D. The Schmalkalden Tools Integrated Complex has 19 plants and a staff of 15,000. It primarily manufactures various cutters, motorized tools, manual tools, wind-powered tools, and die sets.

II. Flexible Manufacturing Systems

The GDR has taken development of flexible automated technological equipment as its primary direction for the machine tools industry in order to satisfy the domestic machinery-manufacturing industry's demand for highly efficient machinery and equipment for large-quantity production and exports, and this will also ensure a high standard for domestic manufacturing technology. There are currently 12 FMSs in use within the GDR (see table 1 for details). By 1990, they will have produced another 60.

Table 1. The Machining Targets of GDR-Manufactured FMSs and Their Economic Results.

Model	Machining target	Workpiece varieties/annual production	Largest workpiece dimension (mm)/weight (kg)	Results (%)				Notes
				M.tools saved	Manpower saved	Aux. time saved	Mach. time saved	
1. FMSs manufactured by the Fritz Heckert Machine Tool Integrated Complex								
FMS400/1-8	Small housing components	38/310,000	—	60	50	65		
FMS630/1-3	Medium-size edged components	14/27,400	600(L)/800	60	70	85		
FMS800	Box housing components	12/31,300	350(L)/20-1,500	77	82	85		
FMS1000/1-7	Medium-size box housing cts.	39/12,000	4001,000(L)/1000	65	70	62	35-70	
FMS1600	Large printer components	—	2,500x1,500x360/1,500	58	76	70		
FMSP2,000/1-1	Large edged components	40/40,000	2,000x1,600x1,000/563,000	52	85			
FMS3016/1-3	Large edged components	—	3,000x1,600x1,600/30,000	30-70	—	20-50	Five-surface machining	
2. FMSs manufactured by the 7 October Machine Tool Integrated Complex								
FMS F/W 250/H6	Symmetric rotational solid parts & box housing components	70/760000	Axial 055, Disk 0300, Box length 400/10	—	—	50	Productivity improved 170-210%	

FMS 250F/ W/4	Symmetric rotational solid parts & box housing components	280/ 320,000	/60	—	—	35	Productivity improved 320%
FMS 250/ 3-2	Casing com- ponents	50 parts per batch	diam. 300, length 200, weight 40	25-50	30-60	20-70	Improved working conditions, improved site distri- bution
FMSFZ 250/W800	Symmetric rotational solid parts comp. (long or short)	10-500 per batch 15/60,000	diam. 250, length 800, weight 30	—	—	70	—

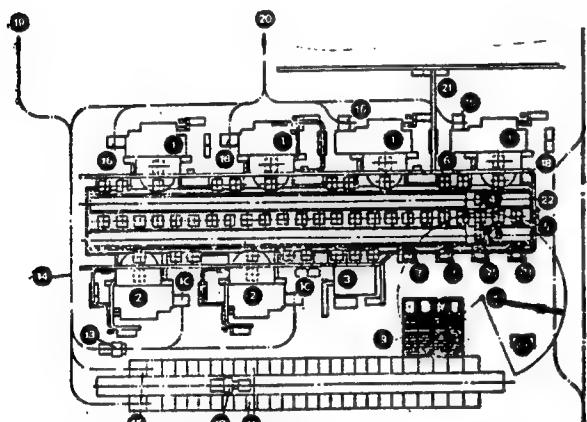


Figure 1. Diagram of the FMS 1000 Layout

Key:

1. CW 1000 machining center
2. CS 1000 machining center
3. Washing and cooling station
4. Track material feed clamp
5. Workpiece table deposit station
6. Knife table deposit station
7. Clamping station
8. Workpiece table waiting position
9. Roller conveyor belt
10. Installation of materials from solid storage
11. Solid storage
12. Workstation for manual measurement
13. Railless conveyor car
14. Railless car track
15. Automatic conveyance station for railless car and solid storage
16. Automatic transfer position for tool container railless car
17. Swing lever crane
18. Safety railing
19. Parts being sent for painting and those for storage as reserves
20. Output tool storage
21. Control facility for transfer and auxiliary work
22. Controller for transfer facility

Aside from the FMSs listed in Table 1 for the Fritz Heckert Machine Tool Integrated Complex, there are also several FMSs composed of machining centers with many stations of the kind, as for example the FMSP 500/1-2 and the FMS 2000/1-4. The 7 October Machine Tool Integrated Complex has been developing FMSs for 15 years, and their various FMSs are listed in Table 1.

The FMS 1000 system comprises four CW 1000 machining centers and two CS 1000 machining centers as hosts (see Figure 1).

Complete machining of boxed solid components can be accomplished with these six stations. Each CW 1000 machining center is fitted with double-cutter inventories, and may be configured with 160 cutters. Components that have been machined on the machining centers are cleaned and dried at the washing and cooling process stations, after which they are sent to the next process for machining or assembly. Each machining center is fitted with the cutter failure indicator shown in Figure 2 [not reproduced]. For inspection, the cutter is moved to the location of the indicator installed at that worksite, where it is compared to reference points and tested for cutter length, by which process cutter failure can be determined and the automatic operation of the machining is guaranteed. If three-position gauges are installed on the main shaft, the clamping position of the workpiece can be recognized, and the error after component processing can be observed. This system can process 39 types of machine tool parts and annually produces 12,000 units of these types, allowing for a 19.5-hour workday.

Figure 3 is a diagram of the FMS 400 layout for machining truck transmission cases. In the figure, 1 is a railless car, 2 is the FC 400k/2 flexible machining cell, 3 is a 1R2P gantry-mounted mechanical hand, 4 is the central solid storage, and 5 is the computer center. See Table 1 for its production program and the economic results.

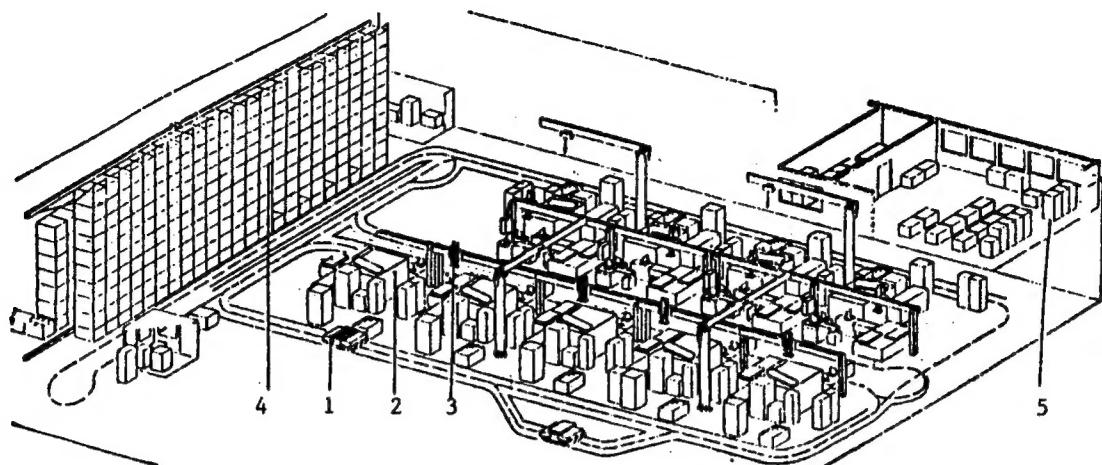


Figure 1. Diagram of the FMS 400 Layout.

The FMS 1600 is primarily used for machining edged large-surface parts for printing machinery or textile machinery. The workpiece uses the automatic clamping device positioning and clamping shown in Figure 4 [not reproduced]. The clamp is fitted with several oil cylinders, and their distribution is determined by the shape of the workpiece. The clasp is fixed on the rotating work platform of the CBFK 150 machining center.

The FMS, for machined solids of rotation and housing components, that is manufactured by the Leipzig Machine Tools Plant comprises 16 processing cells, to which have been added ten manually operated machine tools and machining work places. They call this the "composite FMS." Along the whole line, there are seven railless cars for transporting workpieces, jigs, tools, inspecting tools, and cutting scrap. Materials are fed into and extracted from the lathes by means of a gantry-mounted mechanical hand. This system machines 16-55 mm diameters and 23-640 mm lengths of axial components. It also machines 50-300 mm diameters and 10-290 mm lengths of housing parts. Taking a dc servo motor as an example, this system can machine about 70 of its parts, with annual production of 760,000 pieces at a machining accuracy of IT6, and a lathe usage factor of 80 percent. The system occupies 2,000 square meters of area.

The Leipzig Machine Tools Plant uses an FMS that machines workpieces of multiple surfaces and that was jointly manufactured by the 7 October Machine Tool Integrated Complex and the Finnish company, Nokia. The system consists of three vertical machining centers, one plane grinder, one cleaning station, one UNIMATE 4570 mobile industrial robot, and one PUMA 560 deburring robot. The two robots are provided by the Nokia Company.

The UNIMATE 4570 robot is placed between the solid bulk storage and the lathes, where it moves along tracks. Its features include the ability to directly remove

machined work from the lathe and place it in the solids storage, and the ability to remove work awaiting machining from solid bulk storage and place it within clamps on the machining center or on the magnetic worktable of a surface grinder. The workpiece tray may thus be dispensed with, which simplifies the system and keeps the cost of the FMS about 16 percent lower. There are transducer components on the claw, so it can retrieve work from solid bulk storage, and can also automatically adjust the opening of its claw according to the size of the workpiece.

The PUMA 560 electric industrial robot (Figure 6 [not reproducible]) in the deburring work position has six degrees of freedom. The deburring tool is fixed to a flange on the robot by means of a clamping arm, and the Advanced Robot Programming System (ARPS) is used to correct the axial deviation and speed of movement of the robot. The cutting speed of the deburring tool is continuously adjusted by a frequency converter.

III. Flexible Machining Cells and Machining Centers

In the CW 500 machining center manufactured by the Fritz Heckert Integrated Complex, a new design route has been taken. Its features are: all mechanical and electrical components are connected into a uniform structure, there are no external parts, and it is easy to move and configure. The structure of the machining center is compact, it takes up little room, it does not need a particularly sturdy floor, and as needed it can be easily joined with FMCs and FMSs, as for example the FCW 500, FCW 1000, and the FMSP 500/1-2 and FMSP 800/1000; and it uses a completely hermetically sealed workplace, which reduces pollution and noise from the working environment. It therefore has a broader development aspect. The CW 500 machining center comes with lathes, cutters, and workpiece inspection and monitoring devices, and fault diagnosis is accomplished by

means of a fluorescent screen; cutter failure and breaks can be inspected with a detector, also used for predicting its useful life.

The CFZ series of machining centers is provided with five formats according to the width of their workstations: the 12, 16, 20, 25, 30, and 32. The CFZ 12 and CFZ 16 in that series can be used to make up FMC products. As the customer's processing needs require, he may compose FMSs from CFZs of corresponding formats. The CFZ processing centers are equipped with newly tipped cutter stocks in either the gear tooth style (Figure 8a [not reproducible]) or the tower style (Figure 8b [not reproducible]), which may be installed with 120 cutters. When machining components with these machining centers, drilling, milling, threading, and honing operations can be done on five surfaces with one configuration.

The FCZFO 3 flexible machining cell (Figure 9 [not reproducible]) can machine spur gears having diameters up to 315 mm and hobbing gears having diameters up to 400 mm. The lathe can be controlled via a programmable controller. An electronic gear chain is used between the cutter and the workpiece, which not only improves machining precision, but also simplifies lathe structure. The machine tools are fitted with two revolving storage material devices, which load the workpiece with a mechanical arm as determined by the program, and a finished component transfer device transports the machined workpiece. The machine tools are also fitted with component monitoring devices, which effect unmanned managed work during the last shift of work. As described, use of this unit can improve productivity 130-170 percent, as well as improve quality.

IV. Other Machine Tools

The FFS RWR 63 bearing-ring flexible manufacturing line comprises the SAW 4/PC automatic external bearing grinder, the SIW 3/1 CAC automatic bearing internal grinder, and the "BWF" horizontal transport and material storage system. Figure 10 is a diagram of the BWF installation. The bearing rings enter lathe 1 through elevator 1 from the entrance, and the workpiece that has been machined at lathe 1 is sent into the second-level slipway by means of elevator 2. The workpiece in the slipway is brought forward by a chain, after which it goes into the second lathe for further processing. Parts that have been processed enter the third-level slipway by elevator 3, after which they enter lathe 3. Parts that are finished after lathe 3 go into the exit through the fourth-level slipway. The number of slipway levels may be increased in accordance with the number of connected lathes, to a maximum of ten levels.

The GSU 320 PC automatic threader grinder is a very special machine tool. It is distinguished by an extremely broad machining range: it can machine thread gaps of 0.25-315 mm; it can machine single-start and double-start screw threads; it can machine normal straight outlines and curved tooth outlines; and it can machine

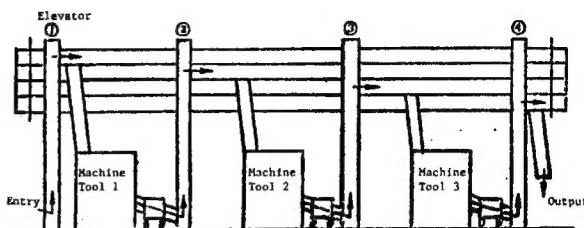


Figure 10. Diagram of Horizontal Transport and Material-Storage System.

thread standards, screwtaps, screw shafts, concave/convex gear outline worm screws, involuted worm screws, double-start worm screws, straight thread cutters, gears, and worm gear hobs and racks. Figure 11 [not reproduced] shows the conditions for processing gear hobs. A multi-toothed gear hob is placed in the clamp and turned by the workpiece main shaft driver, and the gear hobs are ground by using smaller diameter abrasives.

Czech Numeric Control Systems by TESLA Described

24020020 Prague TECHNICKÝ TYDENÍK in Czech
21 Feb 89 p 7

[Article by FD: "TESLA Numeric Control Systems—From Kolin for Our Production Machines"]

[Text] Currently, we are placing very varied requirements upon the functions of electronic control systems. Designer collectives at Tesla Kolin have developed several types of numeric control systems which can fulfill user conditions. Let us, at this time, disregard the failure rate of these devices and let us turn our attention to the offerings made by the Tesla Kolin Enterprise at the "Electronification and Automation 88" Exhibition.

For the Control of Machine Tools

Rectangular Model NS-260 systems are programmed with the aid of a keyboard mounted on a control panel and offer the possibility of standard cassette magnetic tape input. This model and its variation (NS-261) are intended for the rectangular control of milling machines and boring mills. Another system, the NS-560 offers greater programming latitude and is intended for the related control of turret lathes as well as vertical turret lathes requiring two simultaneously controlled coordinates. Testing, diagnostics, and parametric subprograms increase the contribution made by the above systems. These systems can also include the first Czechoslovak NS-580 system for controlling Model OHA-32-NC hobbing mills. It facilitates an easy transition to another cycle of the workpiece, the exchange of the cutting tool, and the immediate adaptation of cutting conditions to the materials of the workpiece.

The Model NS-590 control system is intended to control three linear axes and one rotating axis of profile milling machines. Control is made easier by the use of push buttons and pictorial displays. An editing regime makes it possible to flexibly change the machine constants and to modify the characteristics of the system according to requirements of the operator through the form of a dialogue.

The Model NS-660 CNC system is intended to control automatic lathes with two or four axes calling for linear and circular interpolations. Its programming range offers an editing program, control of the cutting speed, thread cutting, and subprograms controlling parametric programming. Control data can be input with the aid of push buttons on the control panel, with perforated tape, or can be generated as playback during manual control. The NS-670 control system is based on a Model NS-915 programmable automatic machine. It controls three axes having linear interpolations simultaneously in two modes on milling-type machine tools.

For Robotized Work Stations

A Model NS-860 control system was developed as a replacement for the American PKA-20-TP by General Electric for the control of a robotized work station having a metal saw. It consists of the numeric control component, Model NS-951 (compact microcomputer terminal), and a programmable automatic machine, Model NS-905. For purposes of communicating with the operator, it is equipped with a picture display and a flat membrane-type keyboard. It controls all functions of the saw, of the material supply bin, and the manipulator for sorting the cut-out pieces.

The Model NS-880 system can control 4 related axes simultaneously, has a maximum capacity of 7 binary axes, and can communicate with its surroundings (16 input and 16 output signals). It is intended for the control of industrial robots and manipulators. User programs are created by the teach-in method with the aid of a small manual control panel (having its own Model 8035 processor).

The employees of Tesla are making efforts to approach world trends in the application of programmable automatic machines, for example, the Model NS-905, the NS-905/MINI. These are freely programmable control systems of a new generation based on microprocessor circuitry. They are finding application with respect to working machines and technological processes. As examples, we can cite the control of machine tools, foundry machines, control of manipulators, control of assembly lines and galvanizing lines.

Portable programming devices, for example, the Model NS-906 or NS-951 and others, are available for the creation and fine tuning of programs for programmable automatic machines. Programming is accomplished in a

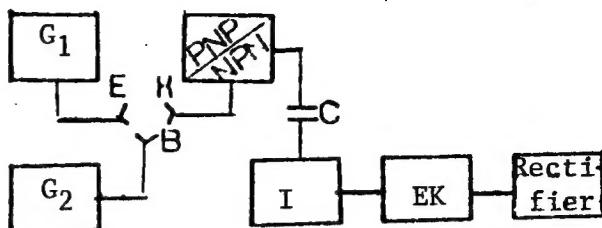


Figure 1. Block Diagram of Instrument.

simple, easily understood problem-oriented language. The above series of control systems is augmented by microcomputer systems for the control of simple tasks in production processes.

Operation of numerically controlled production machines is rendered significantly simpler by the presence of position indicators in the coordinate component. The Model NS-115 pulse position indicator utilizes LED elements and is equipped with integrated circuits produced by CEMA countries.

MICROELECTRONICS

Bulgaria Develops IC/Transistor Quality Control Device

22020007b Sofia VOENNA TEKHNIKA in Bulgarian No 1, 1989 p 32

[Unsigned article: "Transistor and Integrated Circuit Testing Instrument"]

[Text] This instrument, which was developed by Engineer Corps Lieutenant Petko Martinov, makes it possible, without having to remember the structure of transistors (pnp or npn), to determine this structure immediately or, if the transistor is operating properly, to assess the suitability of SN 7400 TTL logic incorporated in the circuit for testing. This is especially useful in seeking defects in individual assemblies or devices. It is a general-purpose instrument which is easy to produce and which greatly reduces the time required for flaw detection. Its principle of operation is simple. A generator G₁ supplies voltage to the transistor to be tested, high or low potential being applied consecutively to the collector and the emitter leads. This changes the polarity of the supply voltage, which does not exceed 3.5 volts and cannot cause breakdown of the junction. At the same time, generator G₂ delivers a signal to the base of the transistor tested.

If the transistor is serviceable, the amplified alternating voltage moves through capacitor C₂ to the input of a rectifier made up of diodes D₄ and D₅. This voltage opens transistor T₁ and the light-emitting diode D₃ incorporated in its circuit emits a light signal indicating that the transistor is serviceable, and periodic lighting of light-emitting diodes D₁ or D₂ reflects the structure (pnp or npn).

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